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ABSTRACTS

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# 34th INDIAN SCIENCE CONGRESS, DELHI, 1947

## SECTION OF MATHEMATICS

PRESIDENT: PROF. D. D. KOSAMBI.

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### 1. On two other Recurrents.

S. C. CHAKRABARTI, Jadavpur.

In this paper are evaluated two other recurrents of which the elements consist of 0, 1 and sums  $1, 2, \dots, r$  at a time of the  $n$  factors given by the  $n$  consecutive powers of  $a$ .

### 2. On the number of cycles associated with a given divisor.

A. A. KRISHNASWAMI AYYANGAR, Mysore.

A general expression has been obtained for the number of distinct recurring cycles associated with any number prime to ten, and upper as well as lower limits have been found for this expression. In particular, when the number is an  $m$ -th power of 99 or 999, the expression reduces to a quadratic in  $m$ , from which the number of distinct cycles associated with 998001 is found to be 1976. Also, if the number is an  $n$ -th power of a prime  $p$ , whose reciprocal has the maximum period  $p-1$ , such that the  $(p-1)$ -th power of 10 less unity is divisible by the square, but not the cube, of  $p$ , then the number of recurring cycles is  $1+p(n-1)$ .

### 3. Some Congruence Properties of Ramanujan's Functions.

R. P. BAMBAH and S. CHOWLA, Lahore.

With the help of some new results obtained by the authors, all known results about the functions  $\tau(n)$  and  $\sigma_k(n)$  are exhibited in a compact tabular form for moduli not exceeding ten. Other results have been extended. A new conjecture has been made to the effect that  $\tau(n) \equiv \sigma_{13}(n) \pmod{2^3}$  if  $(n, 2) = 1$ .

### 4. Some new Congruence Properties of Ramanujan's Function $\tau(n)$ .

D. B. LAHIRI, Calcutta.

Six new congruence properties involving relations between Ramanujan's functions  $\tau(n)$  and  $\sigma_k(n)$  are established. An implication of these results is that  $\tau(n)$  is divisible by  $2^{10} \cdot 3^5 \cdot 5^3 \cdot 7 \cdot 691$  for almost all values of  $n$ .

### 5. On the Fractional Parts of Powers of a positive number.

S. M. SHAH, Aligarh.

Let  $N$  be any real number greater than unity and  $F(x)$ ,  $I(x)$  denote respectively the fractional and integral parts of  $x$ .  $l, m, n$  are any three distinct positive integers in descending order of magnitude. Then  $N$  is a root of an ordinary integer if  $F(N^l) = F(N^m) = F(N^n)$  for the following three cases:

(1)  $l, m, n$  are in A.P. (2)  $l = 2m$  (3)  $m = 2n$  and  $l$  is a multiple of  $n$ .

## 6. The map colouring problem for unorientable surfaces.

R. C. BOSE, Calcutta.

Let  $O(K)$  denote the number of colours both necessary and sufficient to colour any map on an orientable surface of characteristic  $K$  and let  $U(K)$  denote the corresponding number for an unorientable surface.  $f(k) = 3.5 + (12.25 - 6K)\frac{1}{2}$ . Heawood showed that  $O(K)$  cannot exceed  $f(K)$  and surmised that in all cases  $O(K)$  is equal to the integral part of  $f(K)$ . Heffter verified this for  $k=0, -2, -4, -6, -8, -10$ . However, Franklin has shown that  $U(K)$  is not always equal to the integral part of  $f(K)$ , as  $U(0)=6$  whereas  $f(0)=7$ ; but Tietze has verified their equality for  $K=1$ , Kagno for  $K=-1, -2, -4$  and Coxeter for  $K=-3, -5$ . This paper establishes the validity of the relation in question for all  $K$  of the form  $K = -(2t+1)(3t-2)$ ,  $t=1, 2, 3, \dots$  and verifies it for the special values  $K = -10, -13, -33, -55, -68, -153, -185, -299$ .

## 7. On some results involving Legendre functions.

N. G. SHABDE, Amraoti.

The author has previously obtained some integral and expansion relations between the two kinds of Legendre functions. The purpose of the present paper is to generalise these results for all orders and at the same time to establish some more results in their general form.

## 8. On some Properties and the Differential Equation for the MacRobert's function.

N. N. BOSE, Lucknow.

In this paper the author investigates the differential equation for the Mac Robert's E-function and thereby deduces some properties of the E-functions.

## 9. An inversion formula for the generalised Laplace's transform.

R. S. VARMA, Lucknow.

In this paper an inversion formula for  $f(x)$ , where

$$\phi_m^k(p) = p \int_0^\infty (2xp)^{-\frac{1}{2}} W_{k,m}(2xp) f(x) dx$$

is investigated under suitable conditions. The formula is used to develop the theory of this generalised transform.

## 10. A theorem on the generalised Laplace's ; transform.

S. P. KAUSHIK, Bikaner.

The object of this paper is to give the Hankel Transform of the Whittaker Transform of  $f(x)$  in the sense of Varma.

11. On  $(C, 1)$  Summability of Fourier series.

S. D. SINHAL, Lucknow.

The object of this paper is to consider certain conditions, more stringent than those given by B. N. Prasad, for the  $(C, 1)$  summability of the Fourier series of  $f(x)$  at a point  $x$ . It is shown that these conditions are not sufficient to ensure the  $(C, 1)$  summability.



12. On the strong summability of the derived series of a Fourier series.

U. N. SINGH, Allahabad.

By considering an example, it has been proved that the derived series of a Fourier series associated with a function  $f(x)$  of bounded variation is not necessarily strongly summable  $(C, 1)$  at any point where the first derivative of  $f(x)$  exists. Some more properties of the derived series are also established.

13. On Fourier kernels involving two complex variables.

R. P. AGARWAL, Lucknow.

In this paper the author has developed the theory of Fourier Kernels involving two complex variables and has proved Hankel's Theorem for a function of two complex variables.

14. An Extension of Bloch's Theorem.

R. K. RUBUGUNDAY, Saugor.

Bloch's Theorem asserts that the map of a function of a complex variable, whose derivative is regular within and on a circle of unit radius with value unity at the centre of the circle, contains an open circle of radius one-twentyfourth, no point inside the circle corresponding to a value taken more than once by the function. The present paper gives an improved value for the constant than Bloch's value of one-twenty-fourth, while assuming conditions in the open circle against Bloch's conditions in the closed circle. Under the same less stringent conditions the well-known corollary to Bloch's Theorem follows.

15. Segre's Quartic Locus.

SAHIB RAM MANDAN, Lahore.

Using cross-ratios, Pappus' Theorem is established in a space of four dimensions, and thence is deduced the existence of a quadric-point-cone or hyper-cone. Next a double-four of lines is defined whence the existence of an associated set of five lines is deduced. Then is considered the question of drawing planes to meet all the five lines, and it is shown that a single infinity of such planes pass through a point on any one of the five lines, but only two such planes pass through a point not on any line of the set. Conditions under which these two planes coincide are then discussed. Finally is determined the locus of the points through which the planes drawn to meet the lines of an associated set are coincident. This locus is found to be of the fourth order.

16. Motion in incompressible fluids of variable density and varying coefficient of viscosity.

SANTI RAM MUKHERJEE, Benares.

In this paper the density and coefficient of viscosity are regarded as slightly varying, the law of variation being linear in each case. The slow and steady motion, in the manner of Oseen, is discussed, and solutions of hydrodynamical equations arising out of this type of motion have been obtained in certain cases.

17. Irrotational fluid motions superposable on a motion in circles.

RAM BALLABH, Lucknow.

The paper discusses the type of irrotational motions that can be superimposed upon the two-dimensional motion

$$u = -Ky, v = Kx, w = 0, \text{ where } K \text{ is a function of } r.$$

The velocity-potential is given by  $Az^2 + Bz + J(x, y)$ , where  $A$  and  $B$  are constants and  $J$  is a solution of Poisson's equation in two dimensions.

18. Problems connected with supported rectilinear plates.

B. R. SETH, Delhi.

It can be shown how problems concerning buckling and vibrations of supported rectilinear plates can be reduced to finding solutions for the transverse vibrations of rectilinear membranes. Solutions obtained for triangular plates show that the critical load for stability for a right-angled triangular plate containing an angle of sixty degrees is about 35% greater than for a square plate, the area being the same in the two cases.

It can also be shown that the problem of bending of such plates under uniform pressure can be made to depend on the corresponding torsion solution for the boundary. The method has already been applied by the author in a recent paper to the known case of an equilateral plate.

19. Thermal stresses in a semi-infinite elastic solid.

B. SEN, Sibpur.

The object of this paper is to deduce a simple method of solving the problem of thermal stresses and strains in a semi-infinite elastic solid, which has either an initial symmetrical distribution of temperature on the plane boundary or has a nucleus of thermo-elastic strain inside the body.

## SECTION OF STATISTICS

PRESIDENT: R. C. BOSE, M.A., F.N.I.

### Theoretical Statistics

#### 1. Census of Irreducible Polynomials of the Galois Field $GF(p^r)$ .

A. A. KRISHNASWAMI AYYANGAR, Mysore.

A number of interesting theorems, about the irreducible polynomials of degree  $d$  in a Galois field  $GF(p^r)$  have been deduced. For example it has been shown that:

(i) the absolute term in a minimum function of the field must be a primitive root of  $p$ , or its complement, according as  $r$  is even or odd.

(ii) If  $P(x)$  is a minimum function, then  $P(-x)$  is also a minimum function, if  $p$  is a prime of the form  $4n+1$ . The same result holds, if  $r$  is even, and  $p$  is any odd prime.

(iii) The necessary and sufficient conditions for  $x^3-ax-b$ , to be a minimum function of  $GF(p^2)$  are that  $b$  is a primitive root of  $p$ , and that  $a$  cannot be expressed in the form  $m^2+3n^2 \pmod{p}$ .

#### 2. Partial and Multiple Correlation.

RAM BEHARI, Delhi.

In this paper, I have obtained some new expressions for the coefficients of Partial and Multiple Correlation.

#### 3. Some analogues of the amount of information in statistical estimation.

A. BHATTACHARYA, Calcutta.

The problem of estimation is one of the corner stones of statistical theory. Given any  $n$  stochastic variables distributed according to a frequency law containing  $l$  unknown parameters, the problem of estimation is to get a function  $T$  of the variables, whose expectation is equal to a preassigned function  $f$  of the parameters. In particular the parameters themselves may be the objects for estimation. Usually  $f$  admits many estimates (called statistics), and a lower bound of the variances of all such estimates, which is independent of the statistics themselves, but depends only on  $f$  and the frequency law of the varieties, is itself of fundamental importance in the theory of estimation. We can then have an idea about the precision we can hope to get in estimating the function  $f$ .

We know that the reciprocal of the amount of information as defined by Fisher gives such a lower bound. The object of this paper is to improve upon this result, and get a sharper lower bound, which is greater than the expression proposed by Fisher. Incidentally if we equate the variance of Maximum likelihood solution, with this improved result, we get a more correct expression for the variance. Many other interesting results have been deduced and their uses studied.

#### 4. On the expected discrepancy in the estimation (by double sampling) of a variate in terms of a concomitant variate when there exists a non-linear regression between the two variates.

(MRS.) C. BOSE and A. K. GAYEN, Calcutta.

The different aspects of the double sampling technique (which may be otherwise called sampling by concomitant variate), when a linear regression of the form  $y=a+bx$  exists between the two variates have been discussed by Mrs. C. Bose (one of the authors) in Science and Culture (1041-42), and Sankhya (1042). The present

paper considers a particular case of double sampling technique when a non-linear regression of the form  $y = ax^b$  exists between the two variates and gives the appropriate (approximate) large sample formulæ.

The expressions for (1) the variance of the geometric mean of values of the dependent variate  $y$  estimated in terms of values of the concomitant variate  $x$  observed in the 'survey stage', and (2) the expectation of the square of the discrepancy between unknown true mean value and the mean value estimated at the 'survey stage' have been deduced. It is interesting to note that the variance of the mean value in the original plane is equal to that in the logarithmic plane multiplied by a constant factor which is the expectation of the geometric mean of values of the dependent variate  $y$ . The same is the case with the expectation of the square of the discrepancy.

## 5. Application of correlational matrix in problem of regression.

P. K. BOSE, Calcutta.

Aitken developed a method in 1937 for the calculation of a determinant. This method is known as 'Pivotal Condensation'. In this paper the above method has been utilised for the determination of regression coefficients. In problems of educational statistics we have to deal with the inter correlations between a number of tests. With this matrix correlation we can find out the Regression equation of one test with others.

The above method has been employed in an actual problem. A certain number of people have been examined in four subjects, namely English, Mathematics, Vernacular, and History & Geography. A regression equation has been calculated from which we can rank any number of men in their probable order of efficiency in any subject from their test scores in other subjects.

## 6. On the distribution of the generalised mean of the multiple correlation coefficient in K samples and some allied moment calculation.

P. K. BOSE, Calcutta.

In this paper the generalised multiple correlation coefficient  $\bar{R}$  as calculated from  $k$  samples has been defined and its distribution obtained. The expressions for the general moment of certain allied multivariate distributions have been calculated. The shape of the distribution curve for  $\bar{R}$  for various values of the parameters involved has been studied.

## 7. Resolvable solutions of the balanced incomplete block-design

$$v=28, \quad b=63, \quad r=9, \quad k=4, \quad \lambda=1.$$

R. C. BOSE, Calcutta.

A solution of a balanced incomplete design is said to be resolvable when the blocks can be separated into sets such that the blocks of each set contain a complete replication. The present paper discusses two interesting solutions of the design.

$$v=28, \quad b=63, \quad r=9, \quad k=4, \quad \lambda=1.$$

The first is resolvable in 28 different ways, and the second in 10 different ways. The solutions have been derived by considering configurations connected with certain systems of conics and quartics in finite projective spaces.

## 8. The maximum number of factors, which can be accommodated in a symmetrical factorial experiment, when interactions, up to a particular order are left unconfounded.

R. C. BOSE, Calcutta.

Fisher has shown that in a symmetrical factorial experiment in which there are  $s$  alternative levels for each factor (where  $s$  is a prime or a power of a prime), using blocks of size  $s^m$  we can accommodate as many factors as  $(s^m - 1)/(s - 1)$ , without confounding any main effect or two-factor interaction.

It may be asked: what is the maximum number of factors it is possible to accommodate, if it is desired that no main effect or a  $k$ -factor or lower order interaction is confound. Let this number be denoted by  $N(k, m, s)$ . Thus Fisher's result states:

$$N(2, m, s) = (s - 1)/(s - 1)$$

Using the geometrical theory of confounding, developed earlier by Bose and Kishen it has been shown, that the required number  $N(k, m, s)$ , is the maximum number of points it is possible to choose in a finite projective space of  $m-1$  dimensions, based on the Galois field with  $s$  elements, such that no  $k$  of the chosen points should be conjoint. The problem is thus reduced to one of geometrical enumeration. Fisher's number is nothing else than the number of distinct points in the space of  $m$  dimensions. Incidentally the following new results may be stated:

- (i)  $N(3, m, 2) = 2^{m-1}$
- (ii)  $N(3, 3, s) = s+1$ , when  $s$  is odd.  
 $= s+2$ , when  $s$  is even.
- (iii)  $N(3, 4, s) = s^2+1$ , when  $s$  is odd.

## 9. The Patch Number Problem.

R. C. BOSE, Calcutta.

In the theory of sample surveys, we have to distinguish between patterned and random space distributions. One criterion proposed by P. C. Mahalanobis for making this distinction is to compare the observed patch number with the number to be expected on the null hypothesis that the space distribution is random.

The mathematical problem arising here can in its simplest form be formulated in the following way: Consider the system of  $n^2$  small squares or quads formed by dividing a square field A B C D into  $n$  strips parallel to AB, and  $n$  strips parallel to AD. Let there be two colours, say 'black' and 'white'. Let  $p$  be the chance for any qua to be black, and  $q=1-p$  the chance for it to be white. A 'black' patch may be defined to be a system of black quads, any two of which may be joined by a chain of black quads, two consecutive members of the chain having contact along a side. We shall define a 'white patch' in the same manner, except that contact along a corner will also be recognised. A white patch lying completely inside a black patch may be said to be embedded in it. If  $X$  = (the number of black patches) - (the number of embedded white patches) the author had previously obtained the mathematical expectation of  $X$  as

$$E(X) = p + 2(n-1)pq + (n-1)^2 (pq^2 - p^3q)$$

In the present paper the variance of  $X$  has been shown to be

$$\begin{aligned} V(X) = & n^2pq - 4(n-1)p^2q - (6n^2 - 10n + 4) p^2q^2 \\ & - (6n^2 - 40n + 50)p^3q + (14n^2 - 56n + 54)p^3q^3 \\ & + (32n^2 - 104n + 84)p^4q^3 - (9n^2 - 30n + 25)p^4q^4 \end{aligned}$$

These results have been substantially confirmed, by an extensive series of model sampling experiments, carried on in the Statistical Laboratory, Calcutta.

## 10. On a special case of the distribution law of the mean square successive difference.

M. C. CHAKRABARTI, Dacca.

In this paper the distribution of the mean square successive difference, in random samples of size three, from a normal universe with zero mean, and a given standard deviation has been studied. The distribution law has been obtained by an application of the method of characteristic functions, and is found to involve the Bessel function of order zero. The distribution function has also been expanded in the form of an infinite series involving Laguerre polynomials of even degrees, and the  $k$ -th moment about zero has been obtained.

## 11. A note on skewness and kurtosis.

M. C. CHAKRABARTI, Dacca.

Given any  $n$  real numbers  $x_1, x_2, \dots, x_n$ , we can define the quantities  $\alpha_3$  and  $\alpha_4$ , measuring the skewness and kurtosis in the usual manner.

Two inequalities connecting  $\alpha_3, \alpha_4$  and  $n$ , were deduced in an earlier paper. Simpler alternative proofs have been given for them. The following new inequality has been deduced.  $|\alpha_3| \leq \alpha_4 \leq (n+2) + 1/(n-1)$

It has been noted that none of the three inequalities can be further improved.

## 12. The moments and semi-invariants of the distribution law of the mean square successive difference.

M. C. CHAKRABARTI, Dacca.

The object of the note is to obtain the moment generating function in the general case and to calculate from this the moments and semi-invariants. Several elegant recursion formulae have been established and a number of interesting theorems have been proved.

## 13. On the power function of a test of significance for the difference between two proportions.

P. N. CHAKRABARTY, Calcutta.

The hypothesis that two samples of equal size are drawn from the same Binomial population has been considered by C. Chandra Sekar and S. P. Agarwala (Indian Science Congress Abstracts, 1942) and on the assumption that the test of significance to be used is the same as the exact test for homogeneity in a four-fold contingency table, its power function for samples of sizes up to 50 has been worked out by them.

In this paper the critical regions and power functions for samples of sizes 100 and over have been worked out by using certain approximations to the mathematical expressions defining them.

## 14. Representative population set of points for multi-dimensional fields.

BIRENDRANATH GHOSH, Calcutta.

Models for 2-dimensional fields have been already discussed (Science and Culture 7,117 and 9,129). For the general case of  $n$ -dimensional (Euclidean) fields, suitable models can be constructed by associating two or more lower-dimensional models, e.g. a 4-dimensional model can be constructed by orthogonal association of two 2-dimensional models (one triangular and one square, or two hexagons, etc.). If we consider *regular* honeycombs only, that of orthotopes can be had for all values of  $n$ ; alternatives are available only for  $n=2$  and 4. Case of  $n=2$  has been already discussed. For  $n=4$ , models may be only of (a) 16-cell polytopes, or (b) 24-cell ones, besides the (s) orthotopes (8 cell). Honeycombs (a) and (b) are reciprocal, and (c) is self-reciprocal. (Polytopes 'a' and 'c' however are reciprocal and 'b' self-reciprocal). For many purposes, model (b) may be better than (a) or (c), just as for  $n=2$ , hexagonal model is superior to the triangular or square.

Obviously a field for  $n>3$  cannot exist in ordinary space, but only in some representational space. To take a hypothetical example of a micro-climatic survey, the three co-ordinates of ordinary space and one for time will provide the four dimensions of the field, and the variate may be some meteorological factor like temperature, humidity, etc.

Studies in suitable practical procedures for sampling are proceeding.

## 15. Bias in the usual sampling methods for estimating crop yield.

BIRENDRANATH GHOSH, Calcutta.

The total yield of a crop is generally estimated as  $A \times Y$ ,  $A$  being the area under the crop and  $Y$  the yield-rate (per acre, say).

The methods of sampling in current use generally lead to a biased estimate of the total yield.

Some sampling methods are suggested here to remove the bias: (a) direct "area" sampling including non-crop areas (for which  $y=0$ ), and multiplying  $y$  with the total geographical area to get total yield; (very "inefficient"); (b) Some multi-stage modifications of 'a'; (c) direct "area" sampling and rejecting the cuts which are found to fall on non-crop area; proportion of rejections (roughly equal to proportion of land under crop) may be high; (d) if the geographical distribution of the crop-area (not yield) is known beforehand (approximately so under *patwari*-system) other suitable methods can be devised.

## 16. Estimation from an incomplete sample.

BIRENDRANATH GHOSH, Calcutta.

In practical sampling, enumeration is sometimes completed not in all the  $n$  units of the original sample, but in only  $r$  of them. In geographical or "area" sampling such cases may arise indirectly, when the estimate is required over only a part ( $A'$ ) of the original area  $A$ . In this paper the problem of estimation from such incomplete samples has been studied.

## 17. Test of randomness based on relative frequencies.

M. N. GHOSE, Calcutta.

Let  $x_1, x_2, \dots, x_n$  be a sequence of binominal variates assuming values  $\pm \frac{1}{2}$  with equal probability. In this paper the approximate probability of the mean of the first  $k$  variates being numerically less than  $p$  for  $k=1, 2, \dots, n$  has been calculated, the number  $m$  for which  $x_1 = \frac{1}{2}$  being given. This may be used as a subsidiary test when the binomial test fails to show significant departure from the hypothesis  $p = \frac{1}{2}$ . This may also be used to test the randomness of a sequence of variables supposed to have been drawn from the same population.

## 18. Random walk problem in N-dimensions.

M. N. GHOSE, Calcutta.

Let  $Z_1$  be  $n$ -dimensional vectors with the same distribution function depending on the length of  $Z_1$ . In this paper the distribution of  $k$  so that  $k$  is the first number for which  $|Z_1 + Z_2 + \dots + Z_k| > R$  is considered.

19. Impossibility of any cyclical solution for the symmetrical incomplete block design:  $\lambda=2, k=6$ 

V. NARASINHA MURTI, Bombay.

The combinatorial problem involved in the construction of Balanced Incomplete Block Designs for  $\lambda=2, k=6$  has already been successfully solved and the totality of the solutions found. Whereas in the case of  $\lambda=2$ , and  $k=5$  and 9, it was shown that there were 'Cyclical' solutions, it has not yet been established whether there is any Cyclical solution or not in the case of  $\lambda=2, k=6$ . In the following study the impossibility of any Cyclical solution in this case is proved, the method followed being a process of systematic exhaustion of all possible cases.

20. A note on testing for the equality of means of the two characters in a bivariate normal population.

H. K. NANDI, Calcutta.

Consider a sample from a bivariate normal population with the parameters:  $m_1$ ,  $m_2$ ,  $\sigma^2$  &  $\rho$ . If the hypothesis  $m_1 = m_2$  has to be tested in the light of the sample observations independent of  $\sigma^2$ ,  $\rho$  and common value of  $m$ , we may apply: (I) t-test with the differences of the paired values of the two characters forming a sample from a univariate normal population and (II) t-test with a pooled estimate of  $\sigma^2$  based on a larger number of degrees of freedom. A comparison between the two tests reveals the following features: (i) While test I is an exact test, test II is only an approximate one whose exact distribution involves  $\rho$ ; (ii) For only positive values of  $\rho$  the first kind of error is controlled by the test II, error being less than the level of significance; (iii) It is only when  $\rho$  is small—for small samples of five,  $\rho$  must be less than 0.1—that test II scores over test I in controlling the second kind of error.

21. A note on the selection of valid errors in analysis of variance.

H. K. NANDI, Calcutta.

When analysing split-plot or strip-arrangement designs, the mean square due to a particular source of variation has to be tested against an appropriate error. A mathematical set-up leading to the various results of common application has been discussed in this note.

22. Distribution of the median in even samples from a normal population.

K. C. S. PILLAI, Trivandrum.

In this paper the distribution of the mean of the two mid-values in a sample of size  $2n$  taken from a normal population, has been given as a series.

The asymptotic form for large values of  $n$  has also been found, which may be compared with Fisher's form for the median.

23. Bhattacharya's distance function and the general problem of testing of composite hypotheses.

S. N. ROY, Calcutta.

A composite hypothesis may or may not be validly testable. Even if it is validly testable, a uniformly most powerful test may or may not exist. In case a composite hypothesis is validly testable but a uniformly most powerful test does not exist (which happens very often for multiple hypothesis), a test which is most powerful on an average has been considered by Wald in a series of papers where, in the calculation of averages, it has not been possible to relate to any *a priori* rational principles the question of assignment of proper weights.

In the present paper Bhattacharya's distance function for two populations has been suitably generalised to several populations, yielding what might be called a generalised distance function; the distance functions associated with the composite hypothesis (usually tested in analytic statistics) are next considered, some of these having to be constructed.

(i) It is shown that in each case any (*composite*) hypothesis about the distance function itself—which, however has to be carefully distinguished from the associated composite hypothesis which gave rise to the distance function—can be validly tested. (ii) It is next shown that in each case (among these considered) the usual and well-known test of the associated composite hypothesis turns out to be a uniformly most powerful test of the null-hypothesis about the related distance function. (iii) It is further seen that if we view—as we well can in most of the usual cases of multiple hypothesis—the usual test of the associated composite hypothesis as a most powerful test on the average, then the assignment of weights in averaging can be related directly to the distance function which thus provides a uniform and rational basis for averaging in the parametric space.



## 24. Distance function and multivariate analysis of variance.

S. N. Roy, Calcutta.

In earlier papers (some of which were submitted to previous sessions of the Indian Science Congress) the author developed suitable statistical tests for the composite hypothesis involved in multivariate analysis of variance, and derived both on the null and on the non-null hypothesis the joint and next the individual sampling distributions of the relevant statistics usually known as canonical (sample) roots. The status of these roots was earlier examined from the points of view of Neyman and Wald, and it was found that the largest canonical root happened to be an optimum in the sense of Wald, the assignment of weights in averaging being, however, *prima facie* arbitrary. The present paper (i) works out the associated distance function, (ii) brings out that the largest canonical root (for testing the hypothesis involved in multivariate analysis of variance) happens to be the uniformly most powerful test of the null-hypothesis about the associated distance function.

## 25. Distance function and the hypothesis of equality of dispersion matrices for two multivariate normal populations.

S. N. Roy, Calcutta.

In earlier papers by the author suitable tests (in terms of canonical sample roots) were developed and the joint and individual sampling distributions of these roots both on the null and on the non-null hypothesis were worked out. The status of these roots on Wald's theory was examined. The present paper (i) works out the associated distance function, (ii) finds that any (composite) hypothesis about this can be validly tested, and (iii) finally demonstrates that there is a suitable function of the canonical roots which provides a uniformly most powerful test of the null hypothesis concerning the associated distance function.

## 26. Multivariate analogues of certain univariate tests of hypotheses.

S. N. Roy, Calcutta.

The present paper considers the multivariate analogues (other than those covered by papers 24 and 25 above) of some of the usual statistical hypotheses associated with more than one univariate normal population. It is shown how a suitable manipulation of canonical roots provides appropriate tests of these hypothesis—tests which enjoy a status similar to those discussed in papers 24 and 25.

**Agricultural Statistics**

## 27. The effect of colchicine on rice.

P. K. Bose and B. N. Ghosh, Calcutta.

The present paper deals with the result of a pot culture experiment to find out the effect of colchicine treatment on the growth and development of rice plant. Seeds of Dharia aus paddy and their progenies in subsequent years have been treated with colchicine. The experiment has been designed as a randomised block experiment. The data have been analysed for two years.

The treated seeds show a marked improvement as regards yield from control. The experiment will be repeated this year in actual soil condition.

## 28. Multi-stage sampling design in area surveys.

N. T. Mathew, Calcutta.

The problem of crop estimation in any large sized geographical region like a province usually resolves itself into two distinct but closely related problems, namely, (1) estimation of area under the crop in question, and (2) estimation of the per acre yield of the crop. A unistage sampling design is seldom used in the latter problem as that would

involve un-economical expenditure in the field work. But in area surveys, because of the much higher variability necessitating intensive sampling and also because estimates for small administrative units are usually required, unistage designs are generally preferred. In this paper the merits of a multistage design for area surveys are studied based upon material collected during past surveys. It is shown that in certain cases multi-stage designs have definite advantages leading to estimates with increased accuracy at given costs.

## 29. Bias in the use of small size plots in sample surveys for yield.

P. V. SUKHATME, New Delhi, and V. G. PANSE, Indore.

Crop-cutting experiments everywhere in India, according to the official procedure in vogue, are carried out on plots varying from  $1/160$ th to  $1/10$ th of an acre. Those in the random sample surveys on wheat and paddy conducted by the Imperial Council of Agricultural Research and on cotton conducted by the Indian Central Cotton Committee are also carried out on large plots of the same order. In contrast, the plot size used by Hubback and Mahalanobis in Bihar is as small as 12 to 13 sq. ft. Workers in England and America also use similar small plots. The paper contains the results of a number of investigations on the comparison of large and small size plots, including an investigation on paddy in Gaya and Hazaribagh districts in Bihar, in Kistna district in Madras and on cotton at Indore and in the Central Provinces. In the investigation in Gaya and Hazaribagh districts the plot size of 12.5 sq. ft. gave an over-estimation of about 25 per cent. The important feature of the investigation in Kistna district was that the whole of the field was also harvested in addition to the plots of various sizes. The results showed that the yield estimates from large plots and that obtained from harvesting the whole field agreed closely, but small plots over-estimated the yield from 5 to 20 per cent. Unlike paddy in Gaya, Hazaribagh and Kistna districts, the cotton crop on which the experiment was carried, was sown in evenly spaced rows, but the results obtained with plots of different sizes agreed with those from paddy in that  $1/2,000$ th acre plots overestimated yield by nearly 43 per cent. This finding is of a particular importance in relation to the use of small plots in England and America where crops are sown uniformly in rows and the possibility that the yield estimates derived from such plots are seriously biased even in these countries needs a careful examination.

## 30. Area statistics of agricultural crops in India.

P. V. SUKHATME, New Delhi, and V. G. PANSE, Indore.

The extent and quality of the area statistics under agricultural crops in India are described and the relative merits of the complete enumeration vs. random sample surveys are discussed in the light of the Bihar rabi crop survey, 1944, and jute area surveys in Bengal conducted by Mahalanobis. It is considered that the sampling errors of the random survey estimates of area as obtained in these surveys are so high that the estimates are not likely to be useful for many of the administrative purposes for which area statistics are required. The possible reasons for these high sampling errors have been indicated. Complete enumeration, on the other hand, can be relied upon to furnish accurate area statistics with adequate supervision. The recent recommendation of the Bengal Famine Enquiry Commission that complete enumeration should be taken up in permanently-settled areas, is endorsed. It is gratifying that Bihar and Orissa, two of the three permanently-settled provinces, have already introduced complete enumeration of area under agricultural crops by setting up the requisite agency for the purpose.

## 31. Comparison of plots of different sizes and shapes in estimating yield.

M. N. PAITHANKAR, New Delhi.

The paper contains the results of the investigation on crop-cutting experiments on wheat carried out at the Betul Farm and in neighbouring villages in the Central Provinces for comparing  $1/80$ th of an acre plot with those of 12 and 4 sq. ft. approximately. The plots tried out were: (1) two circular plots of radii 2' and 1' respectively, (2) two right-angled isosceles triangles with equal sides 5' and 3' respectively; (3) two rectangular plots of  $4' \times 3'$  and  $2' \times 2'$  respectively. Of

each size there were two plots in a field. Altogether there were 13 plots in a field, including one 1/80th of an acre plot measuring 33' x 16½'. The small plots of 12 and 4 sq. ft. were all harvested by the author and those of 1/80th of an acre were harvested under his personal supervision. Plots of 12 sq. ft. were found to give an over-estimate of 15 to 20 per cent. as compared with that of 1/80th of an acre plot. Plots of 4 sq. ft. gave an over-estimate of approximately 50 per cent. For a given size of plot the shape had negligible influence on yield.

### 32. On a discriminant analysis of the productivity of principal crops in the United Provinces.

A. R. SEN, Lucknow.

Kendall in his paper on 'the Geographical distribution of crop-productivity in England' has considered the yields of ten crops for each of 48 counties and represented the counties as a cluster of 48 points in a ten-dimensional space where the yields of the ten crops for a particular county are regarded as the co-ordinates of a point of the cluster in the ten-dimensional space. He next proceeds to determine the productivity axis as the straight line of closest fit to the cluster and rank the counties in the order of their productivity coefficients, by equations of the type.

$$p_i = l_1 x^i_1 + l_2 x^i_2 + \dots + l_n x^i_n, \quad i = 1, 2, \dots, 48.$$

2. Kendall has thus attacked the problem by giving equal weights to the yields of the individual crops. The present paper deals with the more general problem of determining the most appropriate weights for the yields of the individual crops that would best discriminate the districts on the lines of discriminant function analysis.

3. The yields per acre of five important crops, wheat, paddy, barley, gram and bajra for each of the main groups of the districts of the United Provinces have been separately studied over a period of 10 years.

A preliminary examination of the yield data revealed the existence of three main groups with sub-groups in each, such that the districts within each main group behaved more or less similarly in regard to their differential behaviour in yield per acre towards the five crops but differed from main group to main group. The sub-groups of districts within each main group, though similar in differential behaviour, differed widely in yield per acre in regard to an individual crop.

The method of discriminant function analysis was next applied to obtain the most sensitive linear compound of the yield of five crops that would best discriminate the sub-groups within each main group. Three sets of weights were thus obtained for the yields of the individual crop for each of the main groups.

### 33. Method of estimating the proportion under crop in a sample grid.

J. M. SEN GUPTA, Calcutta.

The usual procedure is to collect the readings of anna proportion occupied by a crop in individual plots of the grid by method of eye-estimation on the field, and then to estimate the area of each plot by graphical methods from which the weighted mean proportion is calculated. This paper suggests a method of constructing grids scanned out into 16 square cells and stamped on the maps, on which the enumerator may actually trace and show in position, the outlines of crop areas. The next step would be to enumerate the crop proportion for each cell by eye-estimation over the map and take the average. The method is extremely economical, as it does away with the costly area extraction and weighting of annas by plot area. The results were in excellent agreement with those obtained by the usual method, even when the cell proportions were read in four-anna units.

### 34. Effect of the fractionisation of plots lying on the border of sample grids on the estimation of crop acreage.

J. M. SEN GUPTA, Calcutta.

In using square grids of a few acres, assumption has to be made of an uniformity of cultivation over the length and breadth of a bordering plot partly included in the

grid, and the total crop-area of such plots is allocated to the grid on this basis. This paper describes an experiment into the effects of this approximation, in course of which it was found that this introduced no bias or any appreciable defect in the estimate. The field enumerator was asked to carry on the usual method and also to show the outlines of crop areas by actual tracings on the map on which the grid was marked. The estimates obtained from the second procedure was found to be practically identical with the first, and the frequency distribution of the differences were symmetrical and almost normal. The experiment used 5200 grids distributed at random over 233 police stations in 25 districts of Bengal and may be considered to have given conclusive results.

### 35. Sample-grid method of Field-enumeration: Linear grids.

J. M. SEN GUPTA, Calcutta.

The usual method is to use square grids and to enumerate for all plots in the grid.

This paper consists of two parts:—The first part describes an experiment using square grids of various sizes, but enumerating the anna estimate for the grid as a whole on the spot. The results compared excellently with those obtained by the usual method. The field cost was almost the same while it did away with listing of plots, area extraction and anna-weighting, which means the heaviest reduction in the laboratory cost.

The second part of the paper, describes an experiment with linear grids which formed the diagonal of the above squares. The enumerator was asked to enumerate annas for those plots only which touched or crossed the diagonal, and show them in position on the map by tracing. The mean proportions obtained by linear measurements were found to agree with those by the usual method, while the co-efficient of variation was about the same as that for the full square. The method of 'linear grids', however gave consistently lower estimates of the mean for all the sizes. This may have been due to a better elimination of the crop-less 'ails' than could be achieved with square grids, but further investigations are needed for confirmation of this hypothesis. The method is cheaper, and may be very useful in area surveys.

## Economic Statistics

### 36. Elasticity of demand of postal articles in India.\*

S. C. SEN GUPTA and G. C. ROY, Calcutta.

An approach is made in this paper to formulate laws of demand and to evaluate elasticity of demand at some specific points of price and demand of certain classes of postal articles in India from data for 57 fiscal years (April to March) viz. 1889-90 to 1945-46, during which period there had been more than two revisions in the rates of such articles.

The results are embodied in the paper itself.

### 37. Use of Indifference Surfaces in Constructing Cost of Living Indices.

K. C. CHERIYAN, Calcutta.

In this paper a short-cut method of constructing cost of living indices when any two out of 'n' Engel Curves are determined for a set of 'n' commodities, is given. The indicator function is assumed to be homogeneous and of the second degree in the 'n' variates and the analysis has to be restricted to middle class family expenditures so that the assumption of linearity of Engel Curves may be valid. The method is quite general and may be extended to cover other types of curves.

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To be presented subject to approval of the department.

## 38. A Note on Estimation of Consumption Requirements.

K. C. CHERIYAN, Calcutta.

The use of family budget data in estimating the consumption requirements of a country is discussed in this paper. A statistic based on mean per-family consumption and on the mean size of family is chosen to represent the total consumption. Its sampling variance is derived in terms of the sampling variances of other variates which are known.

## 39. Distribution of Income in India.

G. C. ROY and A. K. GAYEN, Calcutta.

The paper discusses the problem of the distribution of incomes in India for a number of years before and after the World War II began (Sept. 1939). The part of the distribution of income frequencies lying sufficiently far beyond the modal income has, in this connection, been graduated by the well-known Pareto curve

$$y = ax^{-n}$$

$y$  being, as usual, the number of people having income  $x$  or greater, and  $n$ , as generally observed in a stable economic condition of any country, approximating to 1.5. An evaluation of the index  $n$  and the so-called concentration ratio  $\zeta$  (often considered as a more sensitive index and normally approximating to 0.5) has also been made in this paper. It will be of interest to note here the values of these indices for three outstanding years, *viz.*, 1931-32, being nearly at the mid-depression period, 1938-39, the year just preceding the outbreak of the War, and 1943-44, being one during its pendency.

	1931-32	1938-39	1943-44
$n$	1.5189	1.4838	1.3881
$\rho$	0.4908	0.5085	0.5965

## Vital Statistics

## 40. The ogive curve as a trend of population growth.

S. JANARDANA AIYER, Trivandrum.

The mathematical approach to the study of trends in growing populations is based upon the following three important inferences on the theory of population:—

(1) A growing population  $P$ , is a non-decreasing function of the time ' $t$ ', (2) An optimum value for the population exists and (3) the rate of change of population is a unimodal function of time having high contact at either ends of the time-axis.

The generalised exponential curve, the Gompertz curve and the logistic of Vehrulust, though satisfying the above conditions, are not sufficiently general in character and have been found too inadequate to exhibit the trend in many countries, in particular in India, in a fairly reliable manner. In this paper, another curve, closely similar to the ogive, is suggested as an alternative to the above set of curves, for studying Population Trends. It takes the form

$$P_t = P_{t_0} + \int_{t_0}^t f(t) dt \quad \dots\dots\dots (I)$$

where  $P_t$  = the population in any year  $t$ ,

$t_0$  is the first year of census and  $f(t)$  is any integrable unimodal function of  $t$  satisfying condition (3) above. It has been however found convenient, still retaining its general character to have for  $f(t)$  the form

$$f(t) = \exp. [a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4] \quad (II)$$

Where  $a_4$  is negative and non-vanishing.

The method is illustrated by means of an example. It has been found that this curve gives closer values to the population of Ohio State than those given by H. S. Wills (Annals of Mathematical Stat. Volume I. No. 2, 1930) with the help of a logistic.

## 41. On a method for testing efficacy of inoculation.

N. K. CHAKRAVARTI, Calcutta.

The present paper attempts a systematic study of the methods of ascertaining the efficacy of inoculation as also to evolve conditions under which a statistically accurate relationship may be obtained between mortality rates of inoculated and uninoculated persons of a locality with the incidence of an epidemic. The classical chi-square is not sensitive. We have accepted Dr. Maynard's theory that the resistivities in a population may be represented by a normal curve, the effect of inoculation is to shift the normal curve bodily to the right side, the dispersion changing in the meantime. Epidemic of a specified intensity overpowers resistivity upto a certain point and people having resistivity upto that point succumb. The relationship between the two probits is then linear. The ordinary regression fails since both variables are subject to error. Method of Maximum Likelihood does not lead to a solution other than the ordinary regression. Principal Axis and Mutual regression come to the same thing. We may test for significance of this regression coefficient (1943, *Annals of Math. Stat.*). Wald (1941) has given a simple solution and developed tests. Weights to probits should be assigned according to C. I. Bliss alternately correcting them and getting better approximations.

Data should relate to populations, as homogeneous as possible, divided into small chunks having uniform epidemic incidence rates. There is always bias if we lump together chunks having different intensities of attack unless the standard deviations of the normal curves for the two groups are the same as also the ratios of inoculated persons to uninoculated are the same for all the chunks. These conditions are never satisfied in practice. But a reasonably good fit can be obtained if the data relate to populations as much homogeneous as possible as also to uniform attack rates.

Ordinarily it is not worthwhile undertaking the elaborate calculations unless we are confident that the data conform to the conditions approximately.

## 42. Efficiency of various sampling methods for the estimation of birth and death rates in Madras Presidency.

C. CHANDRA SEKAR, Calcutta.

At present a feasible procedure for obtaining reliable birth and death rates for wide areas in India is by means of sample surveys. But before the technique is applied in any area an efficient survey methodology as suited to it has to be developed. In particular, the optimum size and number of sampling units to be used and the manner in which they are to be selected have to be worked out. In this paper the efficiency of various sampling techniques are compared in regard to their suitability for estimating the birth and death rates in the districts of the Madras Presidency.

## 43. Some aspects of Parsi demography.

C. CHANDRA SEKAR, Calcutta.

The Parsi community in India has grown out of the natives of Iran who migrated from their country in the eighth century to avoid persecution for their faith in the Zoroastrian religion. It is considered that in the last few decades artificial changes in their population have not been of appreciable magnitude. The Parsis do not proselytize, neither do they readily abandon their creed. Between 1891 and 1941 the Parsi population has grown from 89,490 to 114,890, an increase of 28 per cent as compared to 39 per cent increase for the total Indian population. In this paper some of the demographical features of this community have been discussed.

Changes in the age structure, sex composition and civil condition of the community in the different census years have been studied and their social and biological implications have been pointed out.

The vital statistics of the Parsi community in Bombay city have been subjected to a detailed examination and it is shown that the fertility and mortality conditions now prevailing are more akin to the picture amongst western nations rather than amongst the bulk of the Indian population. Life tables constructed for the different censal years show a substantial increase in the expectation of life.

Estimates have been made of the probable size and structure of the Parsi population in the next few decades.

## 44. Distribution of Blood Groups of the O—A—B system amongst Indians.

C. CHANDRA SEKAR and D. N. CHATTERJI, Calcutta.

The records of 16955 Indians who donated to the Blood Banks attached to the All-India Institute of Hygiene and Public Health, Calcutta, the Pasteur Institute, Shillong, and the King Institute, Guindy, have been analysed to bring out the variation in the percentage distribution of the Blood Groups O, A, B and AB as between different areas, religions, castes and tribes. The results obtained have been compared with those recorded by some workers in India and abroad. The castes and tribes have been grouped according to similarity in the distribution of gene frequencies and the extent to which such a grouping fits into a classification of the castes and tribes made by Dr. D. N. Majumdar on the basis of 'Social Distance' has been studied.

## 45. A statistical study of the inheritance of fertility.

N. T. MATHEW, Calcutta.

So far as we are aware no investigation has hitherto been carried out in India to study whether high or low fertility in mothers is associated with corresponding fertility in their offspring. In this paper the material collected from about 350 families in Giridih, Bihar, has been analysed to study this question. It is found that there is a significant positive correlation between the number of children born to a series of mothers and the number of children born to their daughters.

## 46. Studies in war-time demography.

D. V. RAJALAKSHMAN, Madras.

Trends and seasonal variations in births and deaths during the War years (from 1939 to 1945) in the Madras Presidency are studied in this paper. Except municipal towns, 'vital' registration in the province is entrusted to the village officers and the returns of vital statistics are sent to the Director of Public Health. The data for this study are compiled from these statements furnished by the municipalities and the revenue officers. Errors of registration are comparatively more frequent in rural regions than in towns and there is a distinct difference in the living habits of urban and rural populations. Further the extra-ordinary conditions of war-time have varying effects on these two classes. Trends in birth-rate, births according to sex, infant mortality, deaths by age-groups and communities are studied separately for urban and rural areas in this paper besides a study of the trends for the entire province.

Seasonal patterns in birth-rate, infant mortality and death-rate taking into consideration the sex composition, are also worked out by using the methods of ratio to logarithmic moving averages and by the method of eliminating trend by fitting a curve.

**General**

## 47. On Statistical Research in India.

DR. RAMA DHAR MISRA, Lucknow University.

The paper is divided into two parts on the basis of past and future. The past naturally covers the historical background of the statistical work in ancient India as mentioned in the Puranas and in the Arthashastra of Kautilya. Gradually it proceeds on to the well known work by Risley on Anthropometric data and gives a brief survey of the work before 1925. The period from 1925 to the present day which may be called the Mahalanobis period is treated more fully.

The second part discusses some of the problems (of applied Statistics) essentially Indian in character, and others of national importance.

After mentioning some of the theoretical problems that await solution and which have engaged the attention of the statisticians all the world over, the paper discusses briefly the eternal problem of chance versus fate.

## 48. Planning and Organization of Statistics.

D. V. RAJALAKSHMAN, Madras.

Planning on scientific lines comprising every aspect of national life has assumed a special significance in every country in recent years. Economic planning implies the specification of targets to be attained in a given time for ensuring certain levels of economic comforts for all classes of population. Any plan can properly be formulated only after having a clear perspective of the resources which have to be harnessed for achieving the objective. This involves a thorough statistical appraisal of the various factors that enter into the structure of planning. Consequently, organisation of statistics should precede the enunciation of any plan aiming at stepping up the living standards of the masses. This paper deals with the defective nature of existing statistics in India and the necessity of ascertaining the production and capital resources, population and consumption patterns, keeping in view the various plans formulated for the economic development of India in recent years. The need for intensive surveys to estimate the economic potential of various resources available in the country to chalk out a comprehensive plan and to execute it successfully is also considered.

Since this task requires a large body of trained personnel, the problem of a plan for the training of statisticians is also examined. The existing lines on which statisticians are trained at different centres in India are considered and the question as to how best their activities should be expanded is also examined keeping in view the statistical set-up of other countries. Emphasis is also laid on the aspect of co-ordination that should subsist between the Government on the one hand and the Universities and private institutions on the other for evolving a scientific and practicable plan.

## 49. A Study of some Electro-cardiographic Curves.

N. GOPALAKRISHNAN NAIR, Trivandrum.

Among the various instruments of direct practical value in the diagnosis and treatment of cardiac affections, the electro-cardiograph occupies a very prominent place. With the help of this instrument, the cardiac arrhythmias have been differentiated in detail, and those which were formerly unsolved by other instruments such as the polygraph can now be recognised by this instrument. In electrocardiograms the various physiological conditions of the heart, its irregularities and abnormalities are registered by characteristic differences of the curves. By a proper analysis of these curves, it is possible therefore to differentiate such physiological phenomena.

The present paper is a study of the electrocardiographic curves, procured from the Trivandrum General Hospital. Periodogram analysis of these curves has been done and appropriate tests have been applied to detect common components in the physiological conditions of differently affected hearts.

## 50. Long Period Cycles in Rainfall Distribution in Representative Districts of the United Provinces.

A. R. SEN, Lucknow.

The present paper aims at finding the long period cycles after removing the short period tendencies in the annual rainfall distribution, by the method of moving averages for five representative districts of the United Provinces. This has been done by using the ratio of within cycle variations to between cycles variation as an index of dispersion, and cycles obtained corresponding to maximum dispersion, on lines parallel to the method followed in Discriminant analysis and the results compared with the classical method of Periodogram analysis.

## 51. An analysis of public preferences for various cloth designs.

G. D. MATHUR and B. SARKAR, Ahmedabad.

A survey work was taken up at Ahmedabad in order to estimate objectively the tastes and preferences of different groups of consumers, regarding mill cloth.



Figures were collected by inviting persons (of both sexes) at random (to cover all occupational and age groups) to see a cotton cloth exhibition organised by a mill. Opinions were collected from them regarding their choice of goods from samples of representative groups of designs and colour combinations of different sorts of cloth put for this purpose.

The results gives an idea as regards the designs and colour combinations which have grown obsolete as also of the varieties of cloth which are more liked by the public. This in its turn, serves as a guide for manufacturing those designs which have greater consumers' surplus for a given cost of production. The extra consumers' surplus can be converted into producers' profit during normal times.

The results are based on only a particular cross section of opinions of consumers. The survey may be made in other important centres of India.

## 52. A Statistical Analysis on the Effect of Dyeing and Finishing on the strength of particular type of Cotton Cloth.

G. D. MATHUR and B. SARKAR, Ahmedabad.

An experiment was made to study the effect of three different types of finishing treatments on a particular quality of cloth dyed with four different colours.

Different pieces of cloth were selected at random and divided into four different lots at random. Each lot was dyed with one colour. Each dyed lot was then divided into three equal portions at random and subjected to three different finishing treatments. The breaking strength of the cloth was then determined both warp way (length way) and weftway (width way).

The figures were then analysed by the method of analysis of variance.

It was found that the strength of the cloth is greatly altered with different dyes.

It was also found that different finishing treatments were suitable for cloths dyed with different colours.

## 53. An Investigation into the Nature of Sickness of the Textile Mill Workers in Ahmedabad.

G. D. MATHUR & B. SARKAR, Ahmedabad.

This investigation was made with a view to finding the nature of sickness of the textile mill workers working in different departments were the types of work and surrounding conditions (humidity, temperature, etc.) greatly vary.

Figures were collected from a well equipped Mill Hospital where all the workers of the mill are given free treatment (both indoor and out-door) and proper facilities are given to receive treatments.

Incidence of sickness and average duration of sickness of the workers were calculated and classified according to different departments, shifts for different months of the year and compared.

The number of persons per thousand in different departments suffering from different types of diseases was also calculated and compared.



## SECTION OF PHYSICS

PRESIDENT : PROF. K. BANERJEE, D.Sc., F.N.I.

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### Astrophysics

1. On slow homologous change in stars.

G. BANDYOPADHYAY, Calcutta.

It is usually supposed that the stellar evolution takes place by slow homologous contraction during which while the mass remains constant the other physical properties of the star change slowly in a characteristic manner. This assumption was once examined by Dr. L. H. Thomas (*M. N.* Vol. 91, 1930-31, pp. 122-127) when no proper theory of energy generation within a star was developed. The problem is now reconsidered in the light of the law of energy generation formulated by Bethe.

The laws obeyed by the capacity and the generation of energy per unit mass ( $g$ ) so that slow homologous contraction (or expansion) is possible under any one of the three conditions given are fulfilled have been deduced in this paper.

In addition homologous contraction is favoured only for certain relation between the initial density and temperature fields (as was also found by Thomas for the particular case he considered) and the generation of energy.

An investigation of the important case the Cowling Model shows that such a model cannot contract homologously when the generation of energy is confined within the convective core. The conclusion will remain unaltered even when a part of the energy is generated outside the core, as also when the radiation pressure is not neglected within the core.

### Atomic Physics

2. The Landau velocity in liquid helium II.

D. V. GOGATE, Baroda.

The Landau Model and the London-Tisza Model of liquid helium II are compared and an elementary derivation of Landau's expression for the second velocity of sound (in addition to the usual velocity  $dp/dp$ ) in helium II is given from general physical principles.

### Crystal Physics and Crystallography

3. Electrical conductivity of molybdenite crystals.

AJIT KUMAR DUTTA, Calcutta.

The electrical conductivities of some well-developed single crystals of molybdenite have been measured. The measurements have been extended from the room temperature to higher temperatures. The electrical conductivity along the basal plane is about  $10^8$  times greater than that at right angles to the basal plane. At the room temperature for currents both along and at right angles to the basal plane, Ohm's Law is not obeyed. But if the temperature of the crystal is raised to about  $150^\circ\text{C}$  Ohm's Law is perfectly obeyed for currents along both the directions. From the nature of variation of the conductivity with temperature, it has been found that for both directions of the crystal, there are two types of conductivities in it, one type predominates below a temperature of about  $90^\circ\text{C}$  while above that temperature the other type becomes more prominent. If after reaching the highest temperature the crystal is slowly cooled and the observations repeated, it has been found that the temperature-conductivity curves for rising temperature and for falling temperature are not identical, but they have a tendency of forming a loop.

4. Measurement of principal conductivities of single crystals of molybdenite,  $\text{MoS}_2$ , at high temperatures.

ATASI PRABHA BOSE, Allahabad.

The present work is an extension of an earlier work on the measurement of the specific conductivities of single crystals of molybdenite (the electrical and other properties of single crystals of molybdenite,  $\text{MoS}_2$ ).

In the present work observations were made over a range of temperatures 300°K to 600°K. Conductivities in the basal plane as well as in the plane perpendicular to it were measured over the entire temperature range. All the observations were made with very small current (of the order of a few microamperes) passing through the crystal.

The experimental arrangement employed was the same as that used in the earlier experiments, except for the necessary additions for work at high temperatures.

Throughout the range investigated the temperature-co-efficient of resistance along both the principal directions was negative, as was expected of a semi-conductor. The temperature variation of resistances, along the basal plane and in the direction perpendicular to it, were found to be exponential.

5. The directions of the principal magnetic axes and their variations with temperature.

BHAGAWATI CHARAN GUHA, Dacca.

The study of the principal magnetic susceptibilities of single crystals of a large number of salts belonging to the iron group of elements from room temperature down to the lowest temperature obtainable with liquid air, namely 80°K, shows that though in the majority of the crystals the magnetic axes do not change their directions in the above range of temperature, the change is appreciable in some crystals, the largest change observed being 7°.

6. Studies in glass systems—magnetic susceptibility of polar crystals dissolved in borax glass.

SUBODH KUMAR MAJUMDAR, Calcutta.

Different polar crystals like sodium chloride, lithium sulphate, sodium sulphate and potassium sulphate were dissolved in borax. The diamagnetic susceptibilities of these glass pieces were determined in a Magnetic Torsion Balance used by A. K. Datta (*Indian Journal of Physics*, 1944, 18, 249). From the observed mass susceptibility of the glass, the susceptibility of the dissolved crystal was calculated with the help of the Additivity Formula, on the assumption that the value for the solvent borax remained constant. The values thus obtained show very great departure from those of the crystals in the pure solid state as well as in aqueous solution at infinite dilution. The increase in every case is more than 200%—in some cases it is as high as 600%. According to the simple theory of diamagnetism such increase would point to an increase in ionic diameters. Earlier experiments by the author on molerefraction however prove the existence of very considerable deformation in such and similar systems. In the case of two of the four glass systems investigated, the possibility of cationic exchange is excluded and chemical analysis reveals the existence of the salts as such in the glass. That crystal lattices exist in such systems has been demonstrated by the author by X-ray Diffraction experiments.

7. X-Ray investigation of the para-dihalogen derivatives of diphenyl.

JAGATTARAN DHAR, Dhanbad.

The isomorphous crystals of 4—4' difluoro-diphenyl, 4—4' dichloro-diphenyl and 4—4' dibromo-diphenyl have been studied by X-ray methods. The dimensions of the unit cell have been found in each case. They point to the presence of 8 molecules per unit cell. The crystal of 4—4' dichloro-diphenyl has been further studied by the moving film camera. The absence of reflections (OKO) in odd orders suggests that this crystal belongs to the space group  $C2_{2h}$  ( $P 2_1/m$ ) of the monoclinic holohedral class.

8. On the nature of slip planes in glass.

KANWAL SINGH BAWA, Lahore.

The occurrence of slip planes (or glide lamellæ) in metallic and other crystals has long been recognised as a plastic deformation along definite crystallographic directions. Several attempts, notably that of Smekal, Orowan, Polanyi, etc., have been made to explain the mechanism of slipping in crystals.

Recently the present author reported slip planes occurring in glass and studies were made regarding their optical behaviour for the elucidation of their nature.

The constitution of glass also points to the probable mode of their formation.

The structure of glass as worked out by Zacharaisen and Warren from their X-ray studies shows definite inter-ionic distances which means the presence of certain amount of order in the structure of glass.

Thus taking such accepted ideas for the structure of glass it is possible to offer an explanation of the presence of slip planes in glass.

## 9. Extra reflections in Laue photographs of benzil.

R. K. SEN, Calcutta.

Extra reflections in Laue photographs of Benzil with the X-ray beam making various angles with the  $[1\ 0\ \bar{1}\ 0]$  direction have been studied. In an earlier communication Banerjee, Sen and Khan observed that there was an extensive two-dimensional derangement of lattice with wave vectors along planes parallel to  $a^*c^*$  planes of the reciprocal lattice and more intense derangement with wave vector along axes parallel to the basal axes. The present measurements of the positions of the double extra spots belonging to each of the  $(3\ 0\ \bar{3}\ 0)$ ,  $(4\ 0\ \bar{4}\ 0)$ ,  $(3\ 0\ \bar{3}\ 3)$ ,  $(4\ 0\ \bar{4}\ 2)$  planes confirm the above conclusions of Banerjee, Sen and Khan. In the photographs taken with the X-ray beam along  $[1\ 0\ \bar{1}\ 0]$  axis, the intensities of the two extra spots belonging to each of the  $(4\ 0\ \bar{4}\ 0)$ ,  $(4\ 0\ \bar{4}\ 2)$  planes are equal. In the photographs taken with the X-ray beam making  $1^\circ$  with  $[1\ 0\ \bar{1}\ 0]$  axis, however, the two spots approach each other on one side of the central direct beam and separate out on the other side. In the photograph taken with the X-ray beam making  $2^\circ$  with  $[1\ 0\ \bar{1}\ 0]$  axis, the double spots are still discernible but the intensities of the spots nearer to the corresponding Laue spots are greater. Photographs taken with the X-ray beam making  $3^\circ, 4^\circ$ , etc., with  $[1\ 0\ \bar{1}\ 0]$  axis show clearly only one set of spots on one side of the central beam, the intensities falling off with increasing angular deviations.

## 10. Extra reflections in the Laue photographs of pyrene.

R. K. SEN and P. K. HALDER, Calcutta.

Extra spots of the organic crystal of Pyrene have been studied. These spots are diffuse and, therefore, seems to be of thermal origin. Laue photographs of Pyrene were taken with the X-ray beam along and making different angles with  $c^*$  axis, the  $b$  axis being vertical. The positions and relative intensities of the extra spots belonging to the  $(4\ 0\ 0)$ ,  $(3\ 10)$ ,  $(3\ 21)$  planes have been measured. The isodiffusion surface (surface having equal scattering power) around  $(40\ 0)$  reciprocal lattice point of Pyrene has been mapped out.

## 11. Hopf and Lechner's method of evaluating Debye temperatures.

BISHESHWAR DAYAL, Benares.

In order to obtain the Debye characteristic temperature from Born's theory, one has to evaluate an integral over the whole solid angle. It is not possible to evaluate the integral in exact terms, but Hopf and Lechner have given an approximate method of doing it.

The co-efficients have not been given by them, and their paper is not generally available.

After calculating the co-efficients the following values of the Debye characteristic temperatures have been obtained from the room temperature elastic constants.

Al	Ag	Au	Cu	Pb
410	227	171	377	103

## Electricity

## 12. On the electrical polarisation in sulphur.

C. K. SUNDARACHAR, Bangalore.

Eguchi, Gemant, Gross and others have studied the electret behaviour of carnuba wax when exposed to strong electric fields. The author has studied electrical polarisation in sulphur with a sensitive experimental arrangement employing an electrometer tube. The results indicate that sulphur exposed to an electric field at  $130^\circ\text{C}$  gives rise to a feeble electret effect. It is probable that this effect is to be attributed to electric displacement, which is most marked in respect of the monoclinic variety of sulphur.

### Electronics and Ionics

#### 13. Potential variation of the composition of the discharge current by Joshi-effect measurement.

B. N. PRASAD and T. C. JAIN, Benares.

Previous results of Joshi using HE and LF filters (Joshi, *Curr. Sci.*, 1945, 14, 67) and cathode ray oscillograph (Joshi, *Nature*, 1944, 154, 147; Joshi, *Curr. Sci.*, 1944, 13, 253) have shown that the discharge current  $i$  contains  $i_{HF}$ ,  $i_{LF}$  and the supply component  $iS$ ; and furthermore, the net Joshi-effect predominates in  $i_{HF}$ .

A moderate size frame aerial was placed near the chlorine tube and the discharge produced as usual by A.C. excitation at potentials of 5–9 kV (r.m.s.). The aerial current both in dark and when the discharge tube was irradiated, were determined by a Cambridge vacuo-junction and a double diode 6H6 (RCA) used as a full wave rectifier. Observations of  $i$  was next made; first with the whole of the output of the chlorine tube applied to each detector; next with the LF component blocked off by a condenser C of 0.0001  $\mu$ F connected in series with L.T.; finally with  $i_{LF}$  allowed to flow in the detector circuit and  $i_{HF}$  bi-passed to earth through C.

These results show that the ratio of  $i_{L.T.}$  to  $i_{aerial}$  both in dark and light remains constant over the range of potentials mentioned; the ratio of  $i_{HF}$  L.T. to  $i_{aerial}$  and that of  $i_{LF}$  L.T. to  $i_{aerial}$  increase progressively as kV increases. It easily follows that as kV increases  $i_{LF}$  preponderates, and hence that an increase of kV decreases % Joshi-effect. It is also confirmed that change is chiefly in  $i_{HF}$  because the aerial picks up chiefly  $i_{HF}$  and the current in L.T. contains mainly the  $i_{LF}$ .

#### 14. The preferential incidence of the Joshi-effect in oxygen in the high frequency region of the discharge current and its inhibition by resistive impedance.

S. R. MOHANTY, Benares.

The low frequency components of the discharge current  $i$  from a sealed ozoniser containing oxygen and excited by alternating potentials of 50 cycles frequency were by-passed by an iron core inductance; the high frequencies were admitted through a suitable capacity into a low resistance vacuo-junction. The effect percentage change for the changed current was greater than percentage change, for the total (unfiltered) current. When the high frequencies were by-passed by a suitable capacity and the low frequency components of  $i$  were filtered through an inductance both change and percentage, change in this case were markedly smaller than those of the former.

The role of an external resistance R connected serially in the low tension circuit in the Joshi-effect in oxygen under electric discharge was investigated.

The gas contained in a sealed Siemen's tube at a pressure of 27 mm was excited by alternating potentials of 50 cycles frequency. It was found that R markedly diminished the discharge current  $i$  as well as change of current the effect being comparatively pronounced at small values of R.

It is considered that the role of R is, in main, to damp the high frequency components of  $i$  thereby causing the observed inhibition of the Joshi-effect which, as has been shown by Joshi (*Curr. Sci.*, 1944, 13, 253; 1945, 14, 67), has its seat in the high frequency components of the discharge current.

#### 15. Production of the Joshi-effect in oxygen.

S. R. MOHANTY and G. S. KAMATH, Benares.

The Joshi-effect in oxygen was investigated. The results agreed with the general result due to Joshi (*Proc. Ind. Acad. Sci.*, 1945, 22, 389). It was also observed that percentage change was but small in a freshly made ozoniser and reached a constant maximum value after a certain 'ageing.' This agrees with Joshi's theory (*Phys. Sec. Abs.* 26, 1946) that the formation, under discharge, of an activated electrode layer in equilibrium with the excited gas is necessary for the production of change of current characteristic of the system.

The apparent variability of the net Joshi-effect as well as the percentage Joshi-effect with the nature of the A. C. indicator employed has been examined with respect to oxygen using a metal oxide rectifier, a Weston 'cold' rectifier and a vacuojunction as current indicators.

Data were obtained at different exciting potentials when it was found that the nature of the variation of change of current with the applied potential was, in general, the same in all the three cases.

Joshi-effect in oxygen has been studied with a 6H6 double diode and a triode 30 used as half wave rectifiers, and interesting results have been obtained.

The influence of gas pressure has been investigated. It is found that the effect of increasing the gas pressure was first to increase the Joshi-effect and then to decrease it.

The influence of intensity and frequency of irradiation on the above phenomenon in oxygen has been investigated.

In general, the magnitude of the photo-diminution of the discharge current increases with  $I$ , the corresponding light-intensity.

It was also found that both the net Joshi-effect as well as the percentage Joshi-effect are in the order unfiltered white > violet > red > green.

16. Studies of the Joshi-effect with various thermionic tubes and the influence of circuital impedance on Joshi-effect.

K. C. PANDEY, Benares.

In this work a double diode (6H6), triode 30 and pentode (6J7) have been used as current indicators under identical conditions of excitation.

The results show that percentage change is always higher under the anode bend than the grid leak detection. Also, in general, the inductive coupling showed greater percentage change than the resistive coupling. With inductive coupling and otherwise optimum conditions, the Joshi-effect was found to be 47% with the diode, 80% with the triode and 97% with the pentode.

In a series of experiments, under anode bend detection using the triode, percentage change decreased from 38.3 to 2.3 as the kV changed from 4.2 to 5.3; at 5.6 kV, apparently the current increased by 6% and by 12% at 6.7 kV. Results were similar when a pentode was used. Since using a vacuo-junction for current measurement under conditions where the above detectors behaved abnormally, only the negative Joshi-effect was observed.

The relative Joshi-effect was reduced considerably by  $R$  in the L.T. : This reduction was comparatively largest at small  $R$  and at a given applied kV, and also at small kV with a fixed  $R$ . Percentage change increases as a serial capacity  $C$  is decreased. Similarly, when the A.C. detector had a parallel capacity, percentage change decreased, the decrease being greater, the greater the capacity, due to the by-passing of HF.

17. Studies of Joshi-Effect under various conditions.

B. B. PRASAD, Benares.

(a) The extent of variability of change of current with directional irradiation, keeping intensity and frequency-band constant was investigated.

It was found that the percentage photo-diminution in current under transverse and longitudinal irradiation differed appreciably (23.3 and 15.5 respectively, at 1.87 kV). However, the ratio of the two percentage changes = 1.7 remained constant over the entire range of exciting electrical pressure (1.07 to 2.94 kV).

(b) For studying the contribution of H.F. component of the frequency band to Joshi-Effect the measuring circuit consisted essentially of a double diode (6H6) operated on a full wave rectifier and coupled inductively with the L.T. of the Chlorine tube. Pairs of equal by-pass capacitances of increasing values were connected across the input and the corresponding percentage change was determined at potentials varying from 4.8 to 10.7 kV. The influence of these condensers was not only to reduce the magnitude of the change of current and therefore  $i$  as is to be expected from general considerations due to the corresponding by-passing action, but what is more, to reverse the sign of the change.

Instead of an inductive coupling and symmetrical capacitive by-passing, a simple divider input consisting of Dubilier resistances was used. It was observed that a transition from the negative Joshi-Effect to an apparent positive effect occurred as soon as the resistance exceeded a certain critical range.

The influence of resistive impedances superimposed on the rectified D.C. current on Joshi-Effect was also studied.

(c) A vacuo-junction or an oxide type of rectifier, connected in series with the L.T. of Chlorine-tube and the primary of the centre-tapped iron-core transformer coupled to the diode, showed 56.7% diminution in current whereas, at the same instant, diode recorded 12% current increase at 5.87 kV on irradiation. It was very curious to observe that the

very thermo-junction put serially with the micro-ammeter in the D.C. flowing cathode circuit also exhibited 59% decrease while micro-ammeter invariably showed 10% positive Joshi-Effect at the same potential.

(d) Comparative study of Joshi-Effect was made over a wide range of Single and Bi-phase detections, using-double-diode (6H6), and the results are discussed in view of Joshi's theory.

## 18. Production of positive Joshi-Effect in iodine vapour and wall influence of Joshi-Effect in iodine vapour.

S. RANGA RAJA RAO, Benares.

With residual traces of acetone used for filming with iodine solutions the annular surfaces of the ozoniser, the iodine vapour showed unusual behaviour in respect of Joshi-Effect. The author employed an electrode film from an acetone solution of  $I_2 + KI$ ; and a vacuo junction found by Joshi to have a stable and uniform characteristic, as a current indicator. After toppling, the tube was sealed off and excited at 3.2 kV. This on irradiation showed first a negative Joshi-Effect of 45% which under 'ageing' decreased progressively and after 30 hours exposure to discharge gave positive Joshi-Effect of 1,100% current increase under light, which has remained stationary for over two months.

Experiments were made in which iodine was deposited on electrodes, by evaporating off iodine solutions. With ether, the change was negligibly small for iodine and chlorine. Benzene and alcohol showed 15% and 27% Joshi-Effect respectively; it increased to 38% with KI and alcohol. Film of iodoform alone gave no Joshi-Effect; when, however, it was exposed to iodine vapour the Joshi-Effect was 28%. Also, Joshi-Effect increased from nil to over 30 % when the iodoform was just decomposed in situ, by heating at its melting point. With electrode films of alcohol (and KI) and benzene solutions, the Joshi-Effect remained stationary for over 8 months.

Characteristic curves for total current flowing through the low tension of the discharge circuit showed positive Joshi-Effect. In the case of aerial current the positive effect increased with V before ageing and diminished after ageing. Furthermore ageing at constant aerial current showed a reversal of the sign.

## 19. Production of Joshi-Effect in chlorine under wall influence.

B. M. SHUKLA, Benares.

The remarkable sensitivity of Joshi-Effect to changes of the surface nature was studied by introducing in the discharge wall material in divided form.

Inversion of Joshi-Effect was observed (Joshi, Pres. Addr., *Chem. Sec., Indian Sci. Cong.*, 1943) in iodine vapour. It was greatly affected by 'ageing' and was not controllable. Under conditions now reported, the inversion is freer from 'ageing' and what is remarkable, completely potential-reversible.

With conditions described above Joshi's general result with Semi- and full ozonisers that a serial resistance R inhibits the above Effect, was investigated.

The influence of R in the aerial current was also studied: The corresponding negative Joshi-Effect decreases only slightly with R; R affected the positive Joshi-Effect above the inversion-potential inappreciably.

One very suggestive result emerged from this investigation that an identical inversion-potential obtains in the low tension and the aerial current, which latter is the predominantly H.F. part of the conductivity.

The effect of temperature variation on the pronounced surface influence of the walls of the discharge tubes in determining the Joshi-Effect was investigated for the copper-cuprous oxide photo-cell.

In the range of 20°C to 70°C, it was found that the photo-increase of current decreases progressively by about tenfold, the decrease showing a tendency to saturation above 55°C.

## 20. Influence of 'ageing' and production of an apparent positive Joshi-Effect in iodine vapour.

P. L. SARMA, Benares.

Soon after the discovery of the above phenomenon (Joshi, Pres. Addr., *Chem. Sec., Indian Sci. Cong.*, 1943), the occurrence of an apparently appreciable photo-increase of current, it has been observed repeatedly but under conditions hitherto not completely



understood. Following Prof. Joshi, measurements of this phenomenon made with a vacuo-junction have been considered as standard. In the present work the annular space of the ozoniser was filled with Iodine vapour with a trace of alcohol and potassium iodide on the walls. A double diode 6H6 was used as half-wave rectifier at various (low) filament currents, at Prof. Joshi's suggestion that the inter-electrode capacity might be a determinant of the apparent positive effect. It was interesting to observe therefore, in a series of reproducible observations as high as 1,250 per cent. increase in the diode output, when the iodine-tube excited at low potentials was irradiated. At higher voltages, there was a definite inversion to the normal negative Joshi-Effect. The percentage of this last decreases numerically from 6.5 to 4 per cent. by increasing the applied voltage from 0.7 to 1 kilo-volt. Detailed experiments have also shown that the positive effect tends to be reduced numerically on prolonged 'ageing' under the discharge.

## 21. Studies of the "Periodicity Effect" in the interaction of Nitrous Oxide and Hydrogen in the Electric Discharge.

M. A. BHAKTA, Benares.

Joshi and Deshmukh (*Nature*, 1945, 155, 483) observed a remarkable "periodic effect" in the above reaction, in which gas pressure, nature of the glow, discharge current and wattage dissipated in the system during the progress of the change, showed a series of well-defined periodic recurrences. With about 60% of nitrous oxide in the mixture, the author has observed eight periodic loops during about 300 minutes of exposure to the discharge at 515 mm. pressure and 8.1 kV on the ozoniser.

Analysis of the decomposition mixture after 96 minutes from the start of the reaction and when the "periodicity effect" had just set in revealed that 97% of the nitrous oxide is decomposed already. Therefore, the "periodicity effect" is not due to pressure changes due to nitrous oxide decomposition.

Measurements of this H.F. part of the current showed that its time-variation is also subject to a "periodic effect", which is fully in phase with the periodic pressure variation during the nitrous oxide and hydrogen reaction described before. This deduction was further confirmed by the finding that the current picked up by an aerial, which is predominantly H.F., also varied periodically and synchronously with gas pressure. This remark applied also to the "displacement" part, which amounted to about 70% of the total current. As was anticipated when the conduction current was filtered and isolated it showed also a periodic variation.

## 22. Influence of Resistive Impedance on Conduction under Spark Discharge.

H. C. JAIN, Benares.

That the introduction of serial resistance  $R$  decreases both the discharge current  $i$  and the corresponding relative Joshi-Effect, was observed by Prof. Joshi (*Proc. Indian Acad. Sci.*, 1945, 22, 4), who attributed the decrease to the damping of the high frequency components of  $i$ . Spark discharge in air at atmospheric pressure were produced between point electrodes or aluminium disc electrodes about 2 mm apart; and also between brass discs about 2 mm apart. The operative potential was about 12.8 kV. The serial  $R$  was increased from 50 to 4,000 ohms. The current  $i$  was determined with a vacuo-junction and an oxide type rectifier. It was observed that  $i$  decreased first rapidly and then slowly as  $R$  was increased. The suppression of  $i$  by a given  $R$  was comparatively less using the oxide rectifier than the vacuo-junction. The current picked up by an aerial near the discharge tube and which represents chiefly the H.F., diminishes markedly with  $R$ .

The above deduction was confirmed by connecting a capacity between the L.T. electrode and the earth before  $R$ . Through this most of the H.F. was filtered out; the input current consisting of most of the L.F. was found to be comparatively less affected by  $R$ .

## Heat and Thermodynamics

### 23. Elastic behaviour of matter near the melting point.

M. RAMA RAO, Madras.

The compressibility of a large number of substances in the liquid state just above the melting point bears a constant ratio to the compressibility of the same substances in the solid state just below the melting point. Measurements of the velocity of sound of the solid and its melt in the neighbourhood of the melting point shows that there is an abrupt decrease in the velocity to half its value near the melting point for a number of metals. The abrupt change in the elastic constants of the substances when it changes from the solid to the liquid phase is explained on the basis of the simple harmonic model of the solid and liquid phases. It is assumed that the molecules or atoms in the solid vibrate about a fixed

position of equilibrium while in the liquid they vibrate about a slowly displaced equilibrium position.

The ratio of the velocities in the two phases calculated on the above basis are in fair agreement with observed values in the case of simple solids. An explanation is offered for the large increase of compressibility in the case of compounds as being due to the release of internal energy in the liquid phase. The sudden decrease of thermal conductivity of solids near the melting point is also explained on the basis of the above model.

## 24. Electronic laboratory temperature control.

N. R. TAWDE, G. K. MEHTA and I. Q. QADRI, Bombay.

A thermostat working on the principle of expansion of liquids with rise in temperature has been tried in these laboratories where an actual contact of the mercury surface with the electrode has been altogether avoided. This is an electronic regulator in which the change produced in the inductance of a coil with the rise of a mercury thread inside the coil, detunes a high frequency oscillator which operates the relay mechanism thereby controlling the current in the heating circuit. The h.f. oscillator is built round a miniature h.f. triode and is supported by a thermometer passing through its tankcoil. The regulator is found to give better and stable regulation than the usual toluene-mercury regulator and at the same time is easier to set and operate. The details about its construction, working and sensitivity are discussed at length in the paper.

## 25. A new form of Lindemann melting point formula.

BISHESHWAR DAYAL, Benares.

The well-known Lindemann formula connecting the melting point of a solid to its characteristic frequency is based on the assumption that the amplitude of vibration at the melting point is a certain constant fraction of the inter-atomic distance. I have shown that the same point of view yields a general formula connecting  $K$  the force constant arising from a mutual displacement of the nearest atoms,  $r$  the inter-atomic distance and  $T_m$  the melting point of the solid,

$$\frac{nKr^2}{kT_m} \approx \text{constant}$$

where  $n$  is the number of the nearest neighbours of an atom and  $k$  is the Boltzmann constant. Two relations, connecting the elastic constants at the absolute zero to the melting points, discovered by me earlier, have been shown to follow easily from the above considerations.

## 26. Temperature and Pressure variation of Heat Conductivity of Liquids on Osida Theory.

S. R. MOHANTY, Benares.

Arguing from a model of liquid structure similar to that proposed by Andrade in his theory of viscosity of liquids Osida (*Proc. Phys. Math. Soc. Japan*, 1939, 21, 353) deduced a relation between the coefficient of heat conductivity of the liquid, the gas constant, the vibration frequency of the liquid molecules, and the mean inter-molecular distance.

A negative temperature coefficient for the coefficient of heat conductivity of the liquid is to be anticipated. This result, obtained from theory, is in agreement with the findings of Bridgman (*Proc. Am. Acad.*, 1923-24, 59, 141) in the case of all liquids, except water which has a positive temperature coefficient. The behaviour of liquid metals (S. Konno *Tôhoku Univ. Sci. Reports*, 1919, 8, 169) also falls in line with the above deduction.

Bridgman (*loc. cit.*) has shown that the coefficient of heat conductivity increases with pressure, the effect being greater for more compressible liquids, and at 75° than at 30°C. Further, the temperature coefficient of all liquids at pressures above 3000 kg/cm<sup>2</sup> is positive.

The positive temperature coefficient of water, as well as of all other liquids above 3000 kg/cm<sup>2</sup> might, in main, be due to the presence of molecular complexes which would break down into smaller units with temperature rise, the products, as can be seen from this theory, having greater vibration frequency due to their smaller mass.

## Light

### 27. Light Effect and asymmetry of electrodes.

N. R. TAWDE and K. GOPALKRISHNAN, Bombay.

In the light of the explanation advanced by S. K. Mitra and collaborators of the light effect as surface phenomena in ozonizer discharge, some fundamental experiments have been undertaken to examine the asymmetry of electrodes with irradiation of the exciting gas alone, the irradiation of the electrodes, partial irradiation of the electrodes, gas column or of the tube walls and so on. Observations taken so far point to the possibility of the affinity of the walls for the electrons as one of the main factors for the magnitude of the light effect. A number of statistical observations and data are recorded and discussed.

### 28. Characteristics of Photo-flash Lamps.

MOHINDER PRAKASH MURGHAI, Lahore.

The technique for the construction of foil-filled-photo-flash Lamps as developed in this Laboratory is described. The characteristics of the lamps were determined with a specially designed rotating flashometer. Results under the following heads and the causes which lead on to them are available :—

1. Time—lag between contact and start of flash.
2. Total duration of flash.
3. Time required for attaining the peak value of luminosity ;
4. Light at its peak value in lumens.
5. Total energy in lumen-seconds.
6. Spectral distribution of light radiations.

The total energy output of a 100 c.c. bulb is of the order of 40,000 lumen-seconds, and the emission of radiant energy reaches its peak value within 20 milliseconds of the start.

### 29. Intensity and Polarisation of Rayleigh Scattering in Crystals.

K. VENKATESWARLU, Waltair.

The intensity of Rayleigh scattering in calcite and quartz (for different orientations) and also in rocksalt for a random orientation has been compared with that in the case of liquid carbontetrachloride. The depolarisation measurements of Rayleigh scattering in calcite (for different orientations) and in rocksalt have also been made.

## Meteorology

### 30. Theory, Construction and Working of Mahajan's Humimeter.

L. D. MAHAJAN, Patiala.

A new type of hygrometer (Mahajan's Humimeter) has been devised. It has simple construction and is of the size of a table clock. It works on the principle of balance and its theory is the same as that of Mahajan's Optical Hygrometer. The readings of the percentage of humidity are indicated by its pointer directly on the scale marked on its dial.

It is a portable instrument and is useful for factories, workshops, and observatories where and when approximate value of the relative humidity of the surrounding atmosphere is required in a short time.

It is not so accurate as the Mahajan's Optical Hygrometer but is, however, much more accurate than many other types of hygrometers, such as, hair hygrometers, paper hygrometers, chemical hygrometers, etc. Its approximate percentage of error is  $\pm 2$  only.

The details of its construction, working and theory are given in this paper.

## Nuclear Physics

### 31. Accurate Enumeration of Modes of Surface Vibrations and Its Applications.

F. C. AULUCK and D. S. KOTHARI, Delhi.

The usual expression for the number  $a(k)$  of normal modes of surface (Capillary) waves for which the wave-number does not exceed  $k$  is only an asymptotic expression and a more accurate result for  $a(k)$  has been deduced incorporating the order term due to Loo-Keng Hua (*Quart. J. Math.*, 13, 18, 1942). The result given by Vinogradow is found to be incorrect.

In the calculation of the level-spacing for a liquid-drop model of the nucleus the use of the more accurate expression for  $a(k)$  instead of the asymptotic expression modifies the results considerably. Thus, to take one instance, for a nucleus of mass-number 100 and excitation energy of 10 million-volt, the level spacing (ignoring volume waves and considering only the surface waves) is 46 volt (Bethe *Rev. Mod. Phys.* 9, 86, 1937), where—as the above expression gives a separation 85 times larger. This and other applications are discussed in the paper.

### 32. Upper limits of the $\beta$ -ray spectra of Bromin<sup>80</sup> isomers.

N. K. SAHA, Delhi.

The two isomers of bromine 80 with decay periods 18 minutes and 4.2 hours were prepared by activating a sample of ethyle-bromide by slow neutrons from a moderately strong Ra+Be source and precipitating the active bromide chemically by Szilard and Chalmers process. The end-point of the  $\beta$ -ray spectrum of the two periods was measured by absorption method using a G. M. counter and found to be  $2.03 \times 0.34$  MV and  $2.08 \pm 0.28$  MV respectively. Within the limits of the experimental error, the two end-point energies are found to be equal, which lends support to the view that the decay of the metastable state of the Br. 80—nucleus takes place purely through the emission of  $\gamma$ -radiation, and the  $\beta$ -decays take place only in the ground state of the nucleus.

### 33. Study of the Seasonal Variations in Radon Content of the Mineral Springs of Warkala.

A. O. MATHAI, Travancore.

In continuation of the author's previous work on the radio activity of the Mineral springs of Warkala in Travancore, a systematic study of the monthly variation in the radon content of the more active sources is made for one complete year. The results obtained are given along with the rainfall data of the locality. No regular seasonal variation which can be attributed to rainfall is apparent. The average radon content in the case of the most active among the sources is nearly  $12.5 \times 10^{-10}$  curies per litre and fluctuations which are also more in this case are within  $\pm 50\%$  of this value. The work is being continued.

## Spectroscopy

### 34. Self-absorption and splitting of sodium doublet lines.

G. K. MEHTA and N. R. TAWDE, Bombay.

Commercial sodium vapour lamps of "Philora" type—have been observed to give self-reversal combined with broadening in the lines of the  $\lambda 5893$  doublet. We reported some observations lately (*Nature*, 156, 662, 1945) on this phenomenon in a note in collaboration with another author. The magnitude of the splitting as a result of the self-reversal has been found to be 0.064 Å. for  $\lambda 5890$  and 0.053 Å. for  $\lambda 5896$  in almost close agreement with the observations 0.064 and 0.056 resp. of Le Roy Apker of the G. E. C. Research Laboratory (private communication). De Groot's theory of Doppler Broadening could account for a large part of the observed self-reversal. While it is expected that Doppler broadening may be the principal cause of this, we cannot rule out the further possibility of the pressure broadening, Stark broadening and radiation damping mixed with the phenomena. Observations taken in this laboratory under different conditions of sodium vapour lamp reveal some interesting results.

### 35. Broadening of Mercury Lines in Hg.-vapour Lamp.

N. R. TAWDE, G. K. MEHTA and B. S. PATIL, Bombay.

Unlike sodium vapour lamp, it was noticed that self-reversal is absent in principal lines of mercury vapour lamp, but there is considerable broadening in them. Diameter of the discharge tube being different from that of the sodium lamp, it is suspected that this may be the cause of the absence of the self-reversal in spite of the considerable temperature developed under the stabilised conditions of the lamp. Examination and measure of the broadening produced by various exciting currents shows evidence of Doppler broadening, but from its large magnitude, it is not likely to be unmixed with other types especially Stark effect by inter-atomic and ionic fields. Data has been collected to analyse the phenomena.

### 36. Effective Temperatures of Molecules in relation to Temperatures of Sources of radiation.

N. R. TAWDE, Bombay.

Coheur and Coheur (*Phys. Rev.* 69, 240, 1946) have recently discussed a significant result about the formation and emission of AlO molecule. Whatever the aluminium material used or the excitation source employed, they find the same optimum temperature *viz.* 4,000° K. showing that it is the specific property of the particular molecule. The results obtained by workers in these laboratories from the vibrational energy data confirm in general the observations of the above authors from the rotational energy data on the AlO molecule and they are further supported by our observations on the BeO molecule excited from different substances. However, our results on BeO taken along with AlO point to the existence of temperature gradient in the arc (between the core and the periphery), a conclusion unlike the one reported by Coheur and Coheur.

### 37. Isotope Effect in Toluene and Cyclopropane.

B. SUNDARA RAMA RAO, Waltair.

In this investigation, group-theoretical calculations of Isotope Effect have been extended to the cases of Toluene and cyclopropane. The results of investigation are utilized in explaining the Raman spectra of these substances in greater detail than has hitherto been done.

### 38. The Carbon Isotope in Raman Scattering.

B. SUNDARA RAMA RAO, Waltair.

In the present investigation, group-theoretical methods have been applied to a study of the normal frequencies of the  $C_5^{12}C^{13}$  ring. This substitution of a normal carbon atom in the benzene ring by the heavier isotope of mass 13 introduces far-reaching alterations, not only in the magnitudes of the frequencies, but also in the matter of their degeneracies, selection rules and polarisation characters. A detailed calculation is undertaken here as it is hoped that it will be of help in interpreting the Raman spectrum of benzene more fully than has hitherto been done.

### 39. On the development of Lyman Continuum in the vacuum Ultra-violet Region.

B. M. ANAND, Lahore.

A simplified apparatus designed and constructed in this Laboratory for the development of Lyman continuum between 1850 Å to the soft X-ray region is described. Some of the essential features incorporated in the source are :—

- (i) Automatic Collimation ;
- (ii) Efficient cooling of the electrodes ;
- (iii) Ease of capillary replacement ;
- (iv) Use of rubber gaskets for vacuum tight joints.

A critical study of the effect of (a) the dimensions of the capillary, (b) the nature of the material of the tube, (c) the pressure of the gas, (d) the nature of the gas, (e) the capacity of the condenser, and (f) the voltage applied, on the intensity, purity and extent of the continuum has been made.

### 40. Active Nitrogen in sealed bulbs.

B. M. ANAND, Lahore.

Conditions for the constructions of permanently sealed glass bulbs for producing active nitrogen have been studied and described.

### 41. On the Origin of the so-called Boric Acid Fluctuation Bands.

NAND LAL SINGH, Benares.

The New Band System of BO already reported [Nand Lal Singh, *Current Science*, 11 No. 7, p. 276, 1942] involves a transition  $C^4\Sigma-B^2\Sigma$  where  $C^4\Sigma$  is a new level at  $63895\text{ cm}^{-1}$  (7.9 e.v.). This level is shown in the present paper to be the initial level of the well-known boric acid fluctuation bands. The final level is a repulsive state arising out of

$B^2P + O^3P$ . These bands consist of a large number of groups of diffuse bands; each contains a main maximum and a few subsidiary maxima. Main maxima of various orders are fairly well represented by the equation deduced. The subsidiary maxima groups find explanation on the Wave Mechanical formulation [G. E. Gibson, *O.* and N. S. Bayliss, *Phys. Rev.* **44**, 193, 1933] of the Franck Condon Principle.

#### 42. On the Process of Dissociation of $CHX_3$ ( $X$ =halogen).

NAND LAL SINGH and P. VENKATESHWARLU, Benares.

During the course of an investigation of the emission spectra of molecules  $CHX_3$  where  $X$  is a halogen, it has been observed that there is no characteristic band which can be attributed either to the molecule as a whole or to a carbon-halogen group. The emission spectrum of  $CCl_4$  on the other hand contains as is well known the  $C-Cl$  bands. The absence of bands attributable to  $CX$  in the emission spectrum of  $CHX_3$  lends support to and throws further light on the photolytic dissociation of such molecules proposed by earlier workers (Y. P. Parti and R. Samuel, *Proc. Phys. Soc.*, **50**, 5 and R. K. Asundi, N. L. Singh and J. P. Misra, *Current Science*, **12**, 204, 1943). The absorption data, there should occur in the energy level diagram of the process of dissociation of the molecule, levels due to  $(CHX_2 + X)$ ,  $(CHX + 2X)$  and  $(CH + 3X)$  or  $(CX + 2X)$  in increasing order of energy between the ground level and the level of the separation of the molecule (Nand Lal Singh, Thesis for Doctorate). The emission spectra, the presence of the corresponding halogen, hydrogen, and in some cases hydrogen halide. The absence of discrete bands due to  $CX$  indicates that the third of these levels is to be regarded as that of  $(CH + 3X)$  rather than  $(CX + H + 2X)$ . The  $CH$  bands are prominent in iodoform and in bromoform, but are, however, absent in chloroform where the  $C-Cl$  bands are prominent.

#### 43. Study of the Absorption and Emission Spectrum of Toluene.

M. R. PADHYE, Benares.

The absorption of Toluene vapour at atmospheric pressure and at room temperature has been studied. The region of absorption lies between 2750 Å to 2350 Å. On the longer wavelength side of the spectrum bands with definite heads are observed, these diffuse towards the shorter wavelengths. The analysis of these absorption bands has been done on the general lines suggested by H. Sponer (*J. Chem. Phys.*, **10**, 672, 1942). In addition to the frequencies obtained by Sponer the data here obtained show that frequencies 786  $cm^{-1}$  and 520  $cm^{-1}$  are involved in the excited state.

It is very interesting to find that these bands of Toluene can also be excited in a glow discharge transformer as well as high frequency discharge through flowing Toluene vapour. The bands (region 2500—2800 Å) with intensity sufficient for recording them on a Medium Hilger Quartz Spectrograph with an exposure time of about four hours. They seem to be overlapped by a weak continuous spectrum throughout.

#### 44. On the Absorption Spectrum of $HgI_2$ Vapour and its Interpretation.

B. BHATTACHARYA, Benares.

The work on absorption spectrum of mercuric iodide by Wieland shows that the absorption bands in the near and far ultra-violet regions. These bands were correlated by Wieland to different states of dissociation of the  $HgI_2$  molecule, the dissociation being  $HgI$  and  $I$  in their normal or excited states. His interpretation of the absorption data, however, involves four electronic levels (including the ground level) of the molecule in a region in which only three of them are known for certain.

The energy level diagram of the  $HgI_2$  molecule is drawn by the author showing the positions of the absorption maxima and the data on the critical potentials of the molecule as given by Pavlov and Leipunsky from electronic collision experiments. The energy levels of the normal and excited  $HgI$  and the atomic products of dissociation are plotted with respect to the ground level of  $HgI_2$  from a knowledge of the energy of dissociation calculated from the available thermochemical and spectroscopic data.

Among the levels of  $HgI_2$  those at 4.6, 5.5 and 6.4 e.v. are roughly separated by a doublet separation of the iodine atom and hence are correlated to the levels, 3, 3.9 and 4.6 e.v. of the atomic products of dissociation corresponding to  $Hg + I + I$ ,  $Hg + I^* + I$  and  $Hg + I^* + I^*$  where  $I^*$  is an iodine atom in the excited state  $2P_{1/2}$ . The levels at 2.2, 2.5, 2.8, 3.1, 3.4, 3.7, 4.0, 4.3, 4.6, 4.9, 5.2, 5.5, 5.8, 6.1, 6.4, 6.7, 7.0, 7.3, 7.6, 7.9, 8.2, 8.5, 8.8, 9.1, 9.4, 9.7, 10.0, 10.3, 10.6, 10.9, 11.2, 11.5, 11.8, 12.1, 12.4, 12.7, 13.0, 13.3, 13.6, 13.9, 14.2, 14.5, 14.8, 15.1, 15.4, 15.7, 16.0, 16.3, 16.6, 16.9, 17.2, 17.5, 17.8, 18.1, 18.4, 18.7, 19.0, 19.3, 19.6, 19.9, 20.2, 20.5, 20.8, 21.1, 21.4, 21.7, 22.0, 22.3, 22.6, 22.9, 23.2, 23.5, 23.8, 24.1, 24.4, 24.7, 25.0, 25.3, 25.6, 25.9, 26.2, 26.5, 26.8, 27.1, 27.4, 27.7, 28.0, 28.3, 28.6, 28.9, 29.2, 29.5, 29.8, 30.1, 30.4, 30.7, 31.0, 31.3, 31.6, 31.9, 32.2, 32.5, 32.8, 33.1, 33.4, 33.7, 34.0, 34.3, 34.6, 34.9, 35.2, 35.5, 35.8, 36.1, 36.4, 36.7, 37.0, 37.3, 37.6, 37.9, 38.2, 38.5, 38.8, 39.1, 39.4, 39.7, 40.0, 40.3, 40.6, 40.9, 41.2, 41.5, 41.8, 42.1, 42.4, 42.7, 43.0, 43.3, 43.6, 43.9, 44.2, 44.5, 44.8, 45.1, 45.4, 45.7, 46.0, 46.3, 46.6, 46.9, 47.2, 47.5, 47.8, 48.1, 48.4, 48.7, 49.0, 49.3, 49.6, 49.9, 50.2, 50.5, 50.8, 51.1, 51.4, 51.7, 52.0, 52.3, 52.6, 52.9, 53.2, 53.5, 53.8, 54.1, 54.4, 54.7, 55.0, 55.3, 55.6, 55.9, 56.2, 56.5, 56.8, 57.1, 57.4, 57.7, 58.0, 58.3, 58.6, 58.9, 59.2, 59.5, 59.8, 60.1, 60.4, 60.7, 61.0, 61.3, 61.6, 61.9, 62.2, 62.5, 62.8, 63.1, 63.4, 63.7, 64.0, 64.3, 64.6, 64.9, 65.2, 65.5, 65.8, 66.1, 66.4, 66.7, 67.0, 67.3, 67.6, 67.9, 68.2, 68.5, 68.8, 69.1, 69.4, 69.7, 70.0, 70.3, 70.6, 70.9, 71.2, 71.5, 71.8, 72.1, 72.4, 72.7, 73.0, 73.3, 73.6, 73.9, 74.2, 74.5, 74.8, 75.1, 75.4, 75.7, 76.0, 76.3, 76.6, 76.9, 77.2, 77.5, 77.8, 78.1, 78.4, 78.7, 79.0, 79.3, 79.6, 79.9, 80.2, 80.5, 80.8, 81.1, 81.4, 81.7, 82.0, 82.3, 82.6, 82.9, 83.2, 83.5, 83.8, 84.1, 84.4, 84.7, 85.0, 85.3, 85.6, 85.9, 86.2, 86.5, 86.8, 87.1, 87.4, 87.7, 88.0, 88.3, 88.6, 88.9, 89.2, 89.5, 89.8, 90.1, 90.4, 90.7, 91.0, 91.3, 91.6, 91.9, 92.2, 92.5, 92.8, 93.1, 93.4, 93.7, 94.0, 94.3, 94.6, 94.9, 95.2, 95.5, 95.8, 96.1, 96.4, 96.7, 97.0, 97.3, 97.6, 97.9, 98.2, 98.5, 98.8, 99.1, 99.4, 99.7, 100.0, 100.3, 100.6, 100.9, 101.2, 101.5, 101.8, 102.1, 102.4, 102.7, 103.0, 103.3, 103.6, 103.9, 104.2, 104.5, 104.8, 105.1, 105.4, 105.7, 106.0, 106.3, 106.6, 106.9, 107.2, 107.5, 107.8, 108.1, 108.4, 108.7, 109.0, 109.3, 109.6, 109.9, 110.2, 110.5, 110.8, 111.1, 111.4, 111.7, 112.0, 112.3, 112.6, 112.9, 113.2, 113.5, 113.8, 114.1, 114.4, 114.7, 115.0, 115.3, 115.6, 115.9, 116.2, 116.5, 116.8, 117.1, 117.4, 117.7, 118.0, 118.3, 118.6, 118.9, 119.2, 119.5, 119.8, 120.1, 120.4, 120.7, 121.0, 121.3, 121.6, 121.9, 122.2, 122.5, 122.8, 123.1, 123.4, 123.7, 124.0, 124.3, 124.6, 124.9, 125.2, 125.5, 125.8, 126.1, 126.4, 126.7, 127.0, 127.3, 127.6, 127.9, 128.2, 128.5, 128.8, 129.1, 129.4, 129.7, 130.0, 130.3, 130.6, 130.9, 131.2, 131.5, 131.8, 132.1, 132.4, 132.7, 133.0, 133.3, 133.6, 133.9, 134.2, 134.5, 134.8, 135.1, 135.4, 135.7, 136.0, 136.3, 136.6, 136.9, 137.2, 137.5, 137.8, 138.1, 138.4, 138.7, 139.0, 139.3, 139.6, 139.9, 140.2, 140.5, 140.8, 141.1, 141.4, 141.7, 142.0, 142.3, 142.6, 142.9, 143.2, 143.5, 143.8, 144.1, 144.4, 144.7, 145.0, 145.3, 145.6, 145.9, 146.2, 146.5, 146.8, 147.1, 147.4, 147.7, 148.0, 148.3, 148.6, 148.9, 149.2, 149.5, 149.8, 150.1, 150.4, 150.7, 151.0, 151.3, 151.6, 151.9, 152.2, 152.5, 152.8, 153.1, 153.4, 153.7, 154.0, 154.3, 154.6, 154.9, 155.2, 155.5, 155.8, 156.1, 156.4, 156.7, 157.0, 157.3, 157.6, 157.9, 158.2, 158.5, 158.8, 159.1, 159.4, 159.7, 160.0, 160.3, 160.6, 160.9, 161.2, 161.5, 161.8, 162.1, 162.4, 162.7, 163.0, 163.3, 163.6, 163.9, 164.2, 164.5, 164.8, 165.1, 165.4, 165.7, 166.0, 166.3, 166.6, 166.9, 167.2, 167.5, 167.8, 168.1, 168.4, 168.7, 169.0, 169.3, 169.6, 169.9, 170.2, 170.5, 170.8, 171.1, 171.4, 171.7, 172.0, 172.3, 172.6, 172.9, 173.2, 173.5, 173.8, 174.1, 174.4, 174.7, 175.0, 175.3, 175.6, 175.9, 176.2, 176.5, 176.8, 177.1, 177.4, 177.7, 178.0, 178.3, 178.6, 178.9, 179.2, 179.5, 179.8, 180.1, 180.4, 180.7, 181.0, 181.3, 181.6, 181.9, 182.2, 182.5, 182.8, 183.1, 183.4, 183.7, 184.0, 184.3, 184.6, 184.9, 185.2, 185.5, 185.8, 186.1, 186.4, 186.7, 187.0, 187.3, 187.6, 187.9, 188.2, 188.5, 188.8, 189.1, 189.4, 189.7, 190.0, 190.3, 190.6, 190.9, 191.2, 191.5, 191.8, 192.1, 192.4, 192.7, 193.0, 193.3, 193.6, 193.9, 194.2, 194.5, 194.8, 195.1, 195.4, 195.7, 196.0, 196.3, 196.6, 196.9, 197.2, 197.5, 197.8, 198.1, 198.4, 198.7, 199.0, 199.3, 199.6, 199.9, 200.2, 200.5, 200.8, 201.1, 201.4, 201.7, 202.0, 202.3, 202.6, 202.9, 203.2, 203.5, 203.8, 204.1, 204.4, 204.7, 205.0, 205.3, 205.6, 205.9, 206.2, 206.5, 206.8, 207.1, 207.4, 207.7, 208.0, 208.3, 208.6, 208.9, 209.2, 209.5, 209.8, 210.1, 210.4, 210.7, 211.0, 211.3, 211.6, 211.9, 212.2, 212.5, 212.8, 213.1, 213.4, 213.7, 214.0, 214.3, 214.6, 214.9, 215.2, 215.5, 215.8, 216.1, 216.4, 216.7, 217.0, 217.3, 217.6, 217.9, 218.2, 218.5, 218.8, 219.1, 219.4, 219.7, 220.0, 220.3, 220.6, 220.9, 221.2, 221.5, 221.8, 222.1, 222.4, 222.7, 223.0, 223.3, 223.6, 223.9, 224.2, 224.5, 224.8, 225.1, 225.4, 225.7, 226.0, 226.3, 226.6, 226.9, 227.2, 227.5, 227.8, 228.1, 228.4, 228.7, 229.0, 229.3, 229.6, 229.9, 230.2, 230.5, 230.8, 231.1, 231.4, 231.7, 232.0, 232.3, 232.6, 232.9, 233.2, 233.5, 233.8, 234.1, 234.4, 234.7, 235.0, 235.3, 235.6, 235.9, 236.2, 236.5, 236.8, 237.1, 237.4, 237.7, 238.0, 238.3, 238.6, 238.9, 239.2, 239.5, 239.8, 240.1, 240.4, 240.7, 241.0, 241.3, 241.6, 241.9, 242.2, 242.5, 242.8, 243.1, 243.4, 243.7, 244.0, 244.3, 244.6, 244.9, 245.2, 245.5, 245.8, 246.1, 246.4, 246.7, 247.0, 247.3, 247.6, 247.9, 248.2, 248.5, 248.8, 249.1, 249.4, 249.7, 250.0, 250.3, 250.6, 250.9, 251.2, 251.5, 251.8, 252.1, 252.4, 252.7, 253.0, 253.3, 253.6, 253.9, 254.2, 254.5, 254.8, 255.1, 255.4, 255.7, 256.0, 256.3, 256.6, 256.9, 257.2, 257.5, 257.8, 258.1, 258.4, 258.7, 259.0, 259.3, 259.6, 259.9, 260.2, 260.5, 260.8, 261.1, 261.4, 261.7, 262.0, 262.3, 262.6, 262.9, 263.2, 263.5, 263.8, 264.1, 264.4, 264.7, 265.0, 265.3, 265.6, 265.9, 266.2, 266.5, 266.8, 267.1, 267.4, 267.7, 268.0, 268.3, 268.6, 268.9, 269.2, 269.5, 269.8, 270.1, 270.4, 270.7, 271.0, 271.3, 271.6, 271.9, 272.2, 272.5, 272.8, 273.1, 273.4, 273.7, 274.0, 274.3, 274.6, 274.9, 275.2, 275.5, 275.8, 276.1, 276.4, 276.7, 277.0, 277.3, 277.6, 277.9, 278.2, 278.5, 278.8, 279.1, 279.4, 279.7, 280.0, 280.3, 280.6, 280.9, 281.2, 281.5, 281.8, 282.1, 282.4, 282.7, 283.0, 283.3, 283.6, 283.9, 284.2, 284.5, 284.8, 285.1, 285.4, 285.7, 286.0, 286.3, 286.6, 286.9, 287.2, 287.5, 287.8, 288.1, 288.4, 288.7, 289.0, 289.3, 289.6, 289.9, 290.2, 290.5, 290.8, 291.1, 291.4, 291.7, 292.0, 292.3, 292.6, 292.9, 293.2, 293.5, 293.8, 294.1, 294.4, 294.7, 295.0, 295.3, 295.6, 295.9, 296.2, 296.5, 296.8, 297.1, 297.4, 297.7, 298.0, 298.3, 298.6, 298.9, 299.2, 299.5, 299.8, 300.1, 300.4, 300.7, 301.0, 301.3, 301.6, 301.9, 302.2, 302.5, 302.8, 303.1, 303.4, 303.7, 304.0, 304.3, 304.6, 304.9, 305.2, 305.5, 305.8, 306.1, 306.4, 306.7, 307.0, 307.3, 307.6, 307.9, 308.2, 308.5, 308.8, 309.1, 309.4, 309.7, 310.0, 310.3, 310.6, 310.9, 311.2, 311.5, 311.8, 312.1, 312.4, 312.7, 313.0, 313.3, 313.6, 313.9, 314.2, 314.5, 314.8, 315.1, 315.4, 315.7, 316.0, 316.3, 316.6, 316.9, 317.2, 317.5, 317.8, 318.1, 318.4, 318.7, 319.0, 319.3, 319.6, 319.9, 320.2, 320.5, 320.8, 321.1, 321.4, 321.7, 322.0, 322.3, 322.6, 322.9, 323.2, 323.5, 323.8, 324.1, 324.4, 324.7, 325.0, 325.3, 325.6, 325.9, 326.2, 326.5, 326.8, 327.1, 327.4, 327.7, 328.0, 328.3, 328.6, 328.9, 329.2, 329.5, 329.8, 330.1, 330.4, 330.7, 331.0, 331.3, 331.6, 331.9, 332.2, 332.5, 332.8, 333.1, 333.4, 333.7, 334.0, 334.3, 334.6, 334.9, 335.2, 335.5, 335.8, 336.1, 336.4, 336.7, 337.0, 337.3, 337.6, 337.9, 338.2, 338.5, 338.8, 339.1, 339.4, 339.7, 340.0, 340.3, 340.6, 340.9, 341.2, 341.5, 341.8, 342.1, 342.4, 342.7, 343.0, 343.3, 343.6, 343.9, 344.2, 344.5, 344.8, 345.1, 345.4, 345.7, 346.0, 346.3, 346.6, 346.9, 347.2, 347.5, 347.8, 348.1, 348.4, 348.7, 349.0, 349.3, 349.6, 349.9, 350.2, 350.5, 350.8, 351.1, 351.4, 351.7, 352.0, 352.3, 352.6, 352.9, 353.2, 353.5, 353.8, 354.1, 354.4, 354.7, 355.0, 355.3, 355.6, 355.9, 356.2, 356.5, 356.8, 357.1, 357.4, 357.7, 358.0, 358.3, 358.6, 358.9, 359.2, 359.5, 359.8, 360.1, 360.4, 360.7, 361.0, 361.3, 361.6, 361.9, 362.2, 362.5, 362.8, 363.1, 363.4, 363.7, 364.0, 364.3, 364.6, 364.9, 365.2, 365.5, 365.8, 366.1, 366.4, 366.7, 367.0, 367.3, 367.6, 367.9, 368.2, 368.5, 368.8, 369.1, 369.4, 369.7, 370.0, 370.3, 370.6, 370.9, 371.2, 371.5, 371.8, 372.1, 372.4, 372.7, 373.0, 373.3, 373.6, 373.9, 374.2, 374.5, 374.8, 375.1, 375.4, 375.7, 376.0, 376.3, 376.6, 376.9, 377.2, 377.5, 377.8, 378.1, 378.4, 378.7, 379.0, 379.3, 379.6, 379.9, 380.2, 380.5, 380.8, 381.1, 381.4, 381.7, 382.0, 382.3, 382.6, 382.9, 383.2, 383.5, 383.8, 384.1, 384.4, 384.7, 385.0, 385.3, 385.6, 385.9, 386.2, 386.5, 386.8, 387.1, 387.4, 387.7, 388.0, 388.3, 388.6, 388.9, 389.2, 389.5, 389.8, 390.1, 390.4, 390.7, 391.0, 391.3, 391.6, 391.9, 392.2, 392.5, 392.8, 393.1, 393.4, 393.7, 394.0, 394.3, 394.6, 394.9, 395.2, 395.5, 395.8, 396.1, 396.4, 396.7, 397.0, 397.3, 397.6, 397.9, 398.2, 398.5, 398.8, 399.1, 399.4, 399.7, 400.0, 400.3, 400.6, 400.9, 401.2, 401.5, 401.8, 402.1, 402.4, 402.7, 403.0, 403.3, 403.6, 403.9, 404.2, 404.5, 404.8, 405.1, 405.4, 405.7, 406.0, 406.3, 406.6, 406.9, 407.2, 407.5, 407.8, 408.1, 408.4, 408.7, 409.0, 409.3, 409.6, 409.9, 410.2, 410.5, 410.8, 411.1, 411.4, 411.7, 412.0, 412.3, 412.6, 412.9, 413.2, 413.5, 413.8, 414.1, 414.4, 414.7, 415.0, 415.3, 415.6, 415.9, 416.2, 416.5, 416.8, 417.1, 417.4, 417.7, 418.0, 418.3, 418.6, 418.9, 419.2, 419.5, 419.8, 420.1, 420.4, 420.7, 421.0, 421.3, 421.6, 421.9, 422.2, 422.5, 422.8, 423.1, 423.4, 423.7, 424.0, 424.3, 424.6, 424.9, 425.2, 425.5, 425.8, 426.1, 426.4, 426.7, 427.0, 427.3, 427.6, 427.9, 428.2, 428.5, 428.8, 429.1, 429.4, 429.7, 430.0, 430.3, 430.6, 430.9, 431.2, 431.5, 431.8, 432.1, 432.4, 432.7, 433.0, 433.3, 433.6, 433.9, 434.2, 434.5, 434.8, 435.1, 435.4, 435.7, 436.0, 436.3, 436.6, 436.9, 437.2, 437.5, 437.8, 438.1, 438.4, 438.7, 439.0, 439.3, 439.6, 439.9, 440.2, 440.5, 440.8, 441.1, 441.4, 441.7, 442.0, 442.3, 442.6, 442.9, 443.2, 443.5, 443.8, 444.1, 444.4, 444.7, 445.0, 445.3, 445.6, 445.9, 446.2, 446.5, 446.8, 447.1, 447.4, 447.7, 448.0, 448.3, 448.6, 448.9, 449.2, 449.5, 449.8, 450.1, 450.4, 450.7, 451.0, 451.3, 451.6, 451.9, 452.2, 452.5, 452.8, 453.1, 453.4, 453.7, 454.0, 454.3, 454.6, 454.9, 455.2, 455.5, 455.8, 456.1, 456.4, 456.7, 457.0, 457.3, 457.6, 457.9, 458.2, 458.5, 458.8, 459.1, 459.4, 459.7, 460.0, 460.3, 460.6, 460.9, 461.2, 461.5, 461.8, 462.1, 462.4, 462.7, 463.0, 463.3, 463.6, 463.9, 464.2, 464.5, 464.8, 465.1, 465.4, 465.7, 466.0, 466.3, 466.6, 466.9, 467.2, 467.5, 467.8, 468.1, 468.4,

6.9 e.v. of HgI are correlated with those at 2.5, 6.6 and 7.0 e.v. of HgI. The proposed correlation diagram avoids Wieland's assumption of an unobserved extra level of HgI. This hypothetical level at 3.4 e.v. for HgI is postulated to explain the observed fluorescence bands of mercury iodide. If the fluorescence bands are due to the triatomic molecule no such hypothetical level need be invoked.

### Wireless

#### 45. Fading of Short-wave Radio Signals and Diversity Reception.

S. S. BANERJEE and G. C. MUKHERJEE, Benares.

Fading patterns of short-wave radio signals, received in the absence of ground wave, have been recorded at various hours of the day, and it has been observed that the patterns can be divided mainly in three different types, *viz.* : (1) irregular and random variations of peaky type, in which the amplitude of the signal changes rather quickly within approximately 10 seconds, (2) regular or quasi-periodic variations of less rapid type, and (3) slow variations occurring within one minute or more, and possessing periodic or aperiodic characteristic. Of the above types of fading, the first one is most unpleasant to listeners.

Observations have been recorded, both visually and with special automatic recorder constructed for the purpose, on wave bands of 41, 31, 25, 19 and 16 metres, and it has been noted that the fading pattern of signals on a particular band may change from one type to the other during the course of the day. The various types of fading enumerated above have been explained as due to different conditions in the ionospheric layers, assuming the variation of signal intensity to be caused by scattering of radio waves from diffracting centres in the ionosphere.

Based on the above theoretical considerations, it has been shown that space diversity reception for long distances may be accomplished with vertically-spaced aerials fairly close to each other ; and for this, simultaneous observations have been taken with two aerials situated at different heights. It has been observed that the difference in phase in the variations of signal intensities in these aerials is much more pronounced than the difference usually obtained in horizontally-spaced aerials with similar separations.

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## SECTION OF CHEMISTRY

PRESIDENT : DR. P. K. BOSE.

### Inorganic Chemistry

#### 1. Complex Compounds of *m*-phenylenedibiguanide with cobalt and chromium.

PRIYADA RANJAN RAY and BASUDEB DAS SARMA, Calcutta.

In continuation of a previous work by one of us (Ray and Siddhanta, *J. Indian Chem. Soc.*, 200, 1943) on the complex compounds of *m*-phenylenedibiguanide with bivalent metals like Cu and Ni we have now studied the preparation and properties of the complexes formed by the same reagent with trivalent cobalt and chromium, as well as with bivalent cobalt. It has been shown that *m*-phenylenedibiguanide serves as a quadridentate group offering four points of attachment to the central metal atom. With bivalent copper and nickel as well as with trivalent cobalt and chromium it combines equally by means of both primary and secondary valencies giving rise thereby to a class of inner metallic salts of a higher (3rd) order. Because the free amino-groups of the dibiguanide molecule in the complexes generally combine with acids to make the latter behave as electrolytes.

Unlike copper and nickel, bivalent cobalt, does not form with the reagent an inner metallic penetration complex of the square planar type with  $dsp^2$  bonds, but rather gives an associated complex of bright red colour either with ionic or  $sp^3$  tetrahedral bonds, or even  $sp^2d$  planar bonds. This has been verified by measurement of the magnetic moment of the complex chloride, which approximates that of the cobaltous ion.

Trivalent cobalt has been found to give inner metallic penetration complexes of both pure and mixed type with octahedral  $d^2 sp^3$  hybrid bonds. A series of diammino- and diaquo-cobaltic *m*-phenylenedibiguanidinium salts, *viz.* chloride, nitrate, sulphate and oxalate, besides the corresponding hydroxide, has been prepared and studied. A dichloro-cobaltic *m*-phenylenedibiguanidinium chloride has also been prepared in the dry way.

Dicobaltic tris-*m*-phenylenedibiguanidinium salts, namely, chloride, nitrate and sulphate, as well as the corresponding hydroxide, representing complexes of the pure type, have also been prepared.

Tervalent chromium has been found to give complexes only of the pure type, *viz.* dichromium tris-*m*-phenylenedibiguanidinium hydroxide, chloride, nitrate and sulphate. They closely resemble the corresponding cobalt compounds in their properties.

In these complexes of the pure type one of the three *m*-phenylenedibiguanide molecules serves as a bridge between the two metal atoms offering two points of attachment to each through both primary and secondary valencies.

#### 2. The Production of chromic acid by the electrolysis of chromium sulphate in the presence of sulphuric acid.

S. S. JOSHI and G. S. POONIWALA, Benares.

A detailed investigation on the electrolysis of chromium sulphate in the presence of sulphuric acid has been made. Optimum conditions have been worked out for the anodic oxidation of chromium sulphate and sulphuric acid for the preparation of chromic acid. For this the electrolysis of the above mixture has been studied in respect of the influence of the following electro-chemical factors over ranges indicated below :—

Optimum conditions found.			
(i) Conc'n. of $H_2 SO_4$ (0—60%)	...	...	15%.
(ii) Conc'n. of $Cr_2 (SO_4)_3$ (5—50%)	...	...	35%.
(iii) Disposition of electrodes	...	...	Vertical.
(iv) Inter electrode distance (1.5—3.0 cm.)	...	...	2 cm.
(v) Temperature (20°—80°C.)	...	...	40°C.
(vi) Anodic C. D. (100—400 amp./dm <sup>2</sup> .)	...	...	200 amp./dm <sup>2</sup> .
(vii) Cathodic C. D. (100—200 amp./dm <sup>2</sup> .)	...	...	200 amp./dm <sup>2</sup> .
(viii) Current concentration (0.02—0.05 amp./cc.)	...	...	0.04 amp./cc.

Under the optimum conditions, a study was also made of the influence of the duration of electrolysis, nature of the electrode material (lead found to be the best) and the effect of the addition of some sixteen catalysts. Hydrofluoric acid, disodium phosphate, potassium iodate, lead acetate, ammonium molybdate, ferric sulphate, and titanium dioxide improved considerably, in the order shown, the current efficiency for the anodic oxidation.

### 3. Preparation of Alkali Dichromate by the New Electrolytic Method.

S. S. JOSHI and J. M. SAIGAL, Benares.

A new method for the production of potassium permanganate by the electrolysis of a fused mixture of manganese dioxide and potassium nitrate, has been worked out by Joshi and Kant (*Proc. Ind. Sci. Cong.*, 1940. Part III, p. 49). Its extension, in these Laboratories to the preparation of dichromate and arsenate has also been established. In the present work the dependence of the electro-chemical yield of dichromate on the following factors has been investigated : (a) addition agents *viz.*, cobalt sulphate, anhydrous cerium oxide, manganese sulphate, sodium hydrogen phosphate, conc. hydrochloric acid, sodium sulphate, sodium bromide, potassium perchlorate, nickel sulphate, potassium fluoride, vanadium pentoxide ; (b) current density ; (c) duration of electrolysis ; (d) temperature ; (e) bath concentration ; (f) electrode material and (g) wall effect. The general procedure consisted in electrolysis of a fused mixture of chrome iron ore (finely ground) and potassium nitrate under a wide range of conditions mentioned above using iron and platinum electrodes. The optimum conditions worked out are as follows :

Bath concentration : 13 parts of chrome ore and 20 parts of potassium nitrate ; current strength : 2 amperes ; duration of electrolysis : 1 hour ; electrode material : iron rods ; wall effect : porcelain ; catalytic addition : 1.5% of potassium perchlorate. A current efficiency of 38.28% was reached.

The oxides of nitrogen which are liberated profusely during electrolysis can also be utilised as a source of nitric acid.

### 4. Studies on the formation of the Complex Compounds of Potassium Chloride and Mercuric Chloride. Part IV.

L. N. SRIVASTAVA, Lucknow.

Experiments on conductivity and viscosity of mixtures of potassium chloride and mercuric chloride indicate the formation of complex compounds of the molecular formulæ, 4 KCl.HgCl<sub>2</sub> (*Current Science*, Jan., 1946), 2 KCl.HgCl<sub>2</sub>, KCl.HgCl<sub>2</sub> and KCl.2HgCl<sub>2</sub>. The formation of these compounds has been established, and two more compounds of the molecular formulæ 2KCl.3HgCl<sub>2</sub> and 3KCl.2HgCl<sub>2</sub> also appear to exist in solution.

### 5. Complex nickel salts with propylene diamine-bis-acetyl acetone, di-salicylidene propylene diamine and di-salicylidene o-tolidine.

KANAI LAL MANDAL, Calcutta.

Propylene diamine-bis-acetyl acetone has been found to give a nickel compound like ethylene diamine-bis-acetyl acetone. It has the formula NiC<sub>13</sub>H<sub>20</sub>N<sub>2</sub>O<sub>2</sub>. Like the corresponding copper compound, propylene diamine-bis-acetyl acetone nickel compound may be regarded as having a tricyclic structure, all the rings in the compound being, however, 6-membered. This compound which is co-ordinately unsaturated has yielded addition compounds with a molecule of propylene diamine, two molecules of pyridine and two molecules of ammonia. The co-ordination valency in the additive nickel salts is evidently 6. Di-salicylidene propylene diamine has formed a tricyclic nickel compound having the formula C<sub>17</sub>H<sub>16</sub>N<sub>2</sub>O<sub>2</sub>Ni. A similar nickel compound has also been obtained from di-salicylidene-o-tolidine. These compounds, however, do not take up further addenda.

### 6. Chromium Chromates.

S. K. K. JATKAR and V. B. MAINKAR, Bangalore.

The decomposition of CrO<sub>3</sub> and chromates of alkali earths at high temperature by Jatkar *et al* having established the existence of a large number of chromium chromates of general formula aCrO<sub>3</sub>. bCr<sub>2</sub>O<sub>3</sub>, the authors have now confirmed the formation of these compounds by potentiometrically titrating potassium chromates with chrome alum using a platinum electrode. The dE/dC against c.c. curve showed sharp peaks when the ratio of

$\text{CrO}_3/\text{Cr}_2\text{O}_3$  was 1, 2, 3,.....n. Similar titration of potassium permanganate with manganous sulphate reveals the formation of the several known oxides of manganese. This work is being extended to a similar study of compounds of vanadium, molybdenum, tungsten and uranium.

### Physical Chemistry

#### 7. Magnetic study of some heteropolar salts of organic acids.

MATA PRASAD, S. S. DHARMATTI and C. R. KANEKAR, Bombay.

A systematic study of the metallic formates, acetates, oxalates, succinates and tartrates of several cations has been made and by drawing graphs of the molecular susceptibilities of salts containing cations belonging to different sub-groups of the Periodic Table against the atomic number of the cations, values of the susceptibilities of several organic anions have been determined. These anion values have been utilised to evaluate the values of the susceptibilities of cation and important conclusions have been drawn regarding the behaviour of metals in combination with organic anions.

#### 8. Studies in the scattering of Light by Silver Halide Sols.

MATA PRASAD and K. D. VENKATESHA DOSS, Bombay.

A systematic study has been made of the changes in the nature of the micelles in dilute silver halide sols by measuring the extent of polarisation of the scattered light using incident light unpolarised, and vertically and horizontally polarised. The effects of a number of factors, such as concentration of the halide, concentration of gelatin, temperature, ageing, addition of photographic developer, ammonia, hydrogen peroxide, nitric acid, alcohol, etc., have been investigated. The results obtained have been utilized to determine the changes undergone by the micelles, and the conclusions deduced are in conformity with a few of the results obtained by the recent investigations of photographic "emulsions" with the electron microscope.

The changes in the intensity of the light transmitted by some of the typical sols have also been studied and the results obtained indicate that the scattering technique can be used as a valuable tool for the study of the dilute silver halide sols.

#### 9. Formation of Formaldehyde during the Interaction of Carbon monoxide and Hydrogen under Silent Electric Discharge. Part I.

R. H. SAHASRABUDHEY and L. RAMACHANDRA SARMA, Benares.

The investigations by Sahasrabudhey and Veda Raman (*Proc. Ind. Sci. Cong.*, 1946, Part III, Chem. Abst., 51) on the formation of formaldehyde during the interaction of carbon monoxide and hydrogen, subjected to silent electric discharge in Siemen's glass ozonisers have been extended. The influence of the various factors, *viz.*, catalysts, composition of the gas mixture, and the rate of circulation, have been studied at an exciting potential of about 8 to 9 kV and 500 cycles frequency. Formaldehyde, which, according to Löb (*Ber.*, 1904, 37, 3593; *Z. Elektrochem.*, 1906, 12, 2821.) is formed in this reaction, only as an intermediate product that subsequently, with the progress of the reaction, undergoes decomposition, was in the present experiments, removed from the sphere of reaction and thus prevented from undergoing secondary changes, by making the gaseous mixture flow rapidly first through the ozoniser and then through water wash traps, the latter serving to dissolve away soluble formaldehyde. All the experiments were conducted at constant pressure of about 760 mm. The volume of the gas-mixture which was stored in a reservoir, showed a steady decrease as the reaction progressed, but tended to a constant minimum. The course of the reaction was followed by observing this volume decrease with time. Formaldehyde collected in the water traps was estimated by potassium cyanide method (Williams, *J. Am. Chem. Soc.* 1905, 27, 596).

The maximum yield of formaldehyde—about 1% of the weight of the gas-mixture—was obtained with 1 : 1.1 gas-mixture, using a catalyst consisting of a mixture of activated alumina, ferric oxide and chromic oxide with traces of vanadium and thorium oxides as promoters and at a gas flow of 9 litres a minute.

#### 10. Formation of Formaldehyde during the Interaction of Carbon monoxide and Hydrogen under Silent Electric Discharge. Part II. Influence of Catalysts.

R. H. SAHASRABUDHEY and L. RAMACHANDRA SARMA, Benares.

Formation of formaldehyde during the interaction of carbon monoxide and hydrogen subjected to silent electric discharge in Siemen's glass ozonisers at appropriate exciting

potentials and 500 cycles frequency has been observed. In the absence of catalysts the formation of formaldehyde was uncertain, and even when it was formed, it was only in traces and barely sufficient for qualitative detection. A coating of a mixture of activated copper oxide and manganese dioxide on the inner walls of the ozoniser did not improve the yield to any appreciable extent. But when vanadium and thorium oxides were also added in traces the yield was quantitatively estimable. Of the several catalysts so far tried, *viz.*, (1) iron oxide, mixtures of (2) copper oxide and manganese dioxide, (3) iron oxide and aluminum oxide, (4) iron oxide, aluminum oxide and chromic oxide, with traces of vanadium and thorium in each case, were found to give good results, the last mentioned mixture being the best.

# 11. Formation of Formaldehyde during the Interaction of Carbon monoxide and Hydrogen under Silent Electric Discharge. Part III: Influence of composition and rate of circulation.

R. H. SAHASRABUDHEY and L. RAMACHANDRA SARMA, Benares.

The composition of the gaseous mixture and the rate of circulation have a profound influence on the yield of formaldehyde.

Different mixtures of the two gases, varying in composition (1 : 2 to 2 : 1) were tried. It appears that a slight excess of hydrogen over carbon monoxide helps the formation of formaldehyde, the yield being maximum roughly between ratios 1 : 1 and 1 : 1.1. Even a slight excess of carbon monoxide over hydrogen decreased the yield considerably.

The rate of circulation determines the speed with which formaldehyde is removed from the sphere of reaction and thus prevented from getting decomposed; it also affects the efficiency of the absorbers. Rates of circulation below 4 litres a minute yielded very poor results. Maximum yields were obtained when the rates of flow were between 8 and 10 litres a minute. A higher speed tended to help the formation of formaldehyde but minimised the efficiency of absorption. It would appear, therefore, that the low yield obtained by previous workers—they had only qualitatively detected formaldehyde—was due to their having used a system of six ozonisers in parallel by which the rate of circulation through the absorbers was 6 times that through the ozonisers where formaldehyde was formed. A replacement of the system of 6 ozonisers by a single ozoniser produced a marked increase in the yield.

# 12. Influence of Heat on the Physico-Chemical properties of Gum-arabic.

C. S. NARWANI and M. N. MOORJANI, Karachi.

Gum-arabic loses moisture gradually with rise of temperature from 110°-165°C; at 165°C it loses all the moisture it contains. The sample heated to 165°-170°C swells up in water, but does not dissolve; the gel thus formed is non-sticky. It was observed by means of dilatometer that there is contraction in the total volume of water when insoluble gum is left in contact with it. The arabic acid prepared from the same gum by electro-dialysis becomes insoluble when dried at 110°. Fungii does not grow in the aqueous solutions of the samples heated beyond 150°C.

There is no change in the chemical constitution of the gum as shown from the estimations of galactose and arabinose; specific rotation, relative viscosity, refractive index and equivalent conductivity at 37° have been determined for the solutions of the samples heated to 110°, 120°, 130°, 140°, 150°, 160° respectively. The relative viscosity of the solutions of the samples heated to different temperatures from 110° to 160° goes on increasing, while pH value goes on decreasing slightly with rise of temperature. Action of NaOH on the gum-arabic, heated to different temperatures (110° to 170°) has been studied by back potentiometric titrations with HCl. The quantity of NaOH required for reaching the neutral point increases with rise of temperature. This phenomenon has been explained on the basis of difference between ionization of Ca and Na arabates and the different hydration of Ca and Na ions.

# 13. Adsorption of salts by heat-dehydrated gum-arabic and calculation of its hydration in their presence. I. Potassium salts.

C. S. NARWANI and R. K. KESWANI, Karachi.

Apparent adsorption of potassium ions from solutions of KCl, KBr, KI, KNO<sub>3</sub>, KSCN and K<sub>2</sub>C<sub>4</sub>H<sub>4</sub>O<sub>6</sub> of various concentrations (0.2 to 0.8N) by gum-arabic (calcium arabate mainly) made insoluble by heating to 170°, has been measured at 4° and found to vary with the nature of the anion in the order SCN > I > NO<sub>3</sub> > Br > Cl > C<sub>4</sub>H<sub>4</sub>O<sub>6</sub> > SO<sub>4</sub>. By estimating exchanged Ca in the equilibrium solution in each of the above cases,

true adsorption of potassium ions has been calculated. The difference between the apparent and exchange adsorption has been utilised for calculation of the hydration of the gum-arabic in presence of various salts of potassium. The value of hydration thus obtained compares fairly well with that calculated from apparent negative adsorption according to the method, suggested by Heymann and Dockling (*J. Phys. Chem.*, **43**, 522, 1939).

#### 14. Influence of the Constitution of Dyestuffs on their Adsorption by Heat-dehydrated Gum-arabic.

C. S. NARWANI and J. S. BEHRANA, Karachi.

Gum-arabic when dehydrated by heating to 170°C becomes insoluble in water. The dehydrated material was tried as an adsorbent for various dyestuffs.

The insoluble gum has been found to adsorb only basic dyes irreversibly, acid and salt dyes not being adsorbed at all. Electrolytes prevent the adsorption of the basic dyes. The adsorption has been experimentally found to be due to base-exchange, the calcium-ions of the insoluble gum being exchanged for the basic dye ions. Freundlich's adsorption isotherm is followed only in case of malachite green, which is an oxalate. The values of 'a' (adsorption constant) do not show any general relation between adsorption and chemical constitution of dyestuffs, but taking dyes of the same class (triphenylmethane), it increases with the molecular weight.

Lastly it has been observed that the insoluble gum-arabic can be used as a mordant for basic dyestuffs on cotton cloth which is not to be washed with soap, such as the book-binding cloth.

#### 15. Photochemical studies with Uranyl Salts as Sensitisers: Part I. On the Photochemical Reduction of Uranyl Nitrate by Ethyl Alcohol in Light of Frequencies 366, 406, 436, 546 and 578 $\mu$ .

S. K. BHATTACHARYYA and (MISS) SHARDA GULVADY.

The kinetics of the reduction of uranyl nitrate by ethyl alcohol were studied, in detail, in light of different frequencies, *e.g.*, 366, 406, 436, 546 and 578  $\mu$ . The reaction has been found to have the following characteristics: (1) The reaction is zero-molecular with respect to uranyl nitrate; (2) the velocity constant increases with increasing concentration of ethyl alcohol; in fact, the reciprocal of the velocity constant plotted against the reciprocal of the concentration of alcohol gives a straight line; (3) the velocity constant is independent of pH; (4) the velocity constant is directly proportional to the intensity of radiation absorbed; (5) the velocity constant changes with change in the concentration of uranyl nitrate according to the following equation:

$$\frac{dx}{dt} = K_0 \frac{I_{\text{abs by } \text{UO}_2^{++}}}{1 + 35.58 [\text{UO}_2^{++}]}$$

when the concentration of alcohol is 0.018M; (6) the quantum efficiency is high. A mechanism has been suggested which can explain the observed facts.

#### 16. Photochemical studies with Uranyl Salts as Sensitisers: Part II. On the Oxidation of Ethyl Alcohol by Potassium-indigo-tetrasulphonate with Uranyl Nitrate and Uranyl Sulphate as Sensitisers in Light of Frequencies 366, 406 and 436 $\mu$ .

S. K. BHATTACHARYYA and (MISS) SHARDA GULVADY.

The kinetics of the oxidation of ethyl alcohol by potassium-indigo-tetrasulphonate with uranyl nitrate and uranyl sulphate as sensitisers were studied, in detail, in light of frequencies 366, 406 and 436  $\mu$ . The reaction has been found to have the following characteristics: (1) The reaction is zero-molecular with respect to indigo; (2) the velocity constant increases with increase in the concentration of alcohol and in fact, the reciprocal of the velocity constant plotted against the reciprocal of the concentration of alcohol gives a straight line; (3) the velocity constant is independent of the concentration of indigo; (4) the velocity constant is independent of pH; (5) the velocity constant is directly proportional to the intensity of radiation absorbed by uranyl salt; (6) the velocity constant changes with change in the concentration of uranyl salt according to the following equation:

$$\frac{dx}{dt} = K_0 \frac{I_{\text{abs by } \text{UO}_2^{++}}}{1 + 1.136 [\text{UO}_2^{++}]}$$

when the concentration of alcohol is 0.87 M; (7) the quantum efficiency is much less than unity.

17. Conductance of Salts in Non-Aqueous Solvents: Part I. Conductance of Salts in Triethanolamine.

S. K. BHATTACHARYYA and S. N. NAKHATE, Bangalore.

Conductivities of a number of electrolytes, *e.g.*, tetraethylammonium chloride, tetraethylammonium chlorate, tetramethylammonium chloride, tetramethylammonium chlorate, tetramethylammonium perchlorate, ethylamine hydrochloride, hydrochloric acid, sulphuric acid and sodium, were determined under different experimental conditions using triethanolamine as a solvent.

The equations of (1) Debye-Hückel-Onsager and of (2) Fuoss and Kraus were tried on the experimental results. Considering the fact that the above equations are valid for strong electrolytes at great dilutions, the results could be explained more or less satisfactorily even though the solutions studied were moderately concentrated. The variation of conductivity with increasing temperature has been found to be quite normal and the plot of  $\Lambda_c$  against  $T$  (temperature) passes through a maximum as in most non-aqueous solvents. Walden's rule fails completely in triethanolamine as a solvent. The mobility of tetraethylammonium ion in triethanolamine as a solvent has been calculated and found to be 0.0355.

18. Conductance of Salts in Non-Aqueous Solvents: Part II. Conductance of Salts in Ethylphenylethanolamine.

S. K. BHATTACHARYYA and S. N. NAKHATE, Bangalore.

Conductivities of a number of electrolytes, *e.g.*, tetraethylammonium chloride, tetramethylammonium picrate, ethylamine picrate, ethylamine hydrochloride, *p*-nitrophenol, sodium, benzamide and sodium picrate, were determined under different experimental conditions using ethylphenylethanolamine as a solvent. The results show a great contrast to those in triethanolamine as a solvent (Part I of the series). The  $\Lambda_c = \sqrt{c}$  curves are much steeper and cannot be trusted to give even approximate values of  $\Lambda_c$ . These curves show minima. After the minimum the conductivity rises sharply towards greater concentration. In the case of tetraethylammonium chloride which was studied in a wide range of concentration, in addition to a minimum, a maximum occurs. It has been found in all cases that the portion of the curve beyond the minimum towards greater dilution has a slope of  $-\frac{1}{2}$  which shows that the mass action law holds good between ions and ion-pairs.

18a. Variations of equivalent conductance with concentration of the aqueous and non-aqueous solutions of some long-chain fatty acids.

S. N. MUKHERJEE and B. K. CHATTERJEE, Jadavpur, Calcutta.

Equivalent conductance of butyric, caprylic, lauric and myristic acids was studied in different concentrations of their solutions in water, methyl alcohol, ethyl alcohol and acetone. The nature of the curves observed present the following characteristic features: (i) excepting butyric acid which presents an almost straight graph, sloping downwards with increasing value of  $C$ , all other acids both in aqueous and non-aqueous solvents exhibited steep downward slopes from very low concentrations without indication of the existence of any critical concentration; (ii) the second rise of the curve at higher concentrations was evident only in the case of aqueous solutions of caprylic and lauric acids. In no case the tendency to a second rise at higher concentrations was noticeable in any non-aqueous solvents. Inevitable conclusions from these are that in all probability the process of aggregate formation also proceeds in non-aqueous solvents as well, right from very low concentrations although the solutions in latter cases appear clearer and thus present the characteristics of a true solution as opposed to colloidal suspension which occurs in aqueous solutions where the aggregate formation to colloidal dimensions is more or less apparent.

18b. Variation of the activity of hydrogen ions with concentration in aqueous solutions of a few long chain fatty acids.

S. N. MUKHERJEE and B. N. BHATTACHARYA, Jadavpur, Calcutta.

Hydrogen ion activity of some long chain fatty acids (caprylic, lauric, myristic acids) has been determined at various concentrations of their aqueous solutions. Results represented graphically as the hydrogen ion activity per equivalent of the acid (specific hydrogen ion activity) against concentration of the acids in equivalents show that the

specific hydrogen ion activity diminishes as the concentrations of the acid increases to a minimum value beyond which the curves show distinct rise. This latter tendency is more prominent as the number of carbon atoms in the acid goes up. This part of the curve is specially interesting in view of the fact that at such high concentrations the acids show a distinct tendency to release some of the hydrogen ions which were bound either in the ionic atmosphere or in the double layer surrounding the acid micelles. It may be mentioned that palmityl amine hydrochloride also behaves similarly with respect to its chlorine ion activity. An explanation has been indicated in the light of Mukherjee's double layer theory.

#### 19. Formation of Complex Compounds between Lead Nitrate and Alkali Nitrates: Part I. The System: $\text{Pb}(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ .

M. R. NAYAR and C. S. PANDE, Lucknow.

A survey of literature shows that there is evidence for the formation of one complex compound between lead nitrate and potassium nitrate of the formula:  $2\text{KNO}_3 \cdot \text{Pb}(\text{NO}_3)_2$ . A systematic study now undertaken has revealed the presence of at least three compounds. The method adopted is to prepare stock solutions of 1 M strength of each of the two salts separately; 20 c.c. of  $\text{KNO}_3$  are then pipetted out into a small measuring flask of capacity 60 c.c., the requisite quantity of  $\text{Pb}(\text{NO}_3)_2$  are added from a burette and the solution made up to the mark by addition of water. In this way 25 solutions are made in which the concentration of  $\text{KNO}_3$  remains the same, while that of  $\text{Pb}(\text{NO}_3)_2$  varies systematically from 0 M to  $2/3$  M.

The following physico-chemical properties of such a set of solutions have been studied, namely, density, freezing point, conductivity, viscosity, surface tension, and from the two latter rheochor and parachor were also calculated. By the application of the 'Mixture law equation' the parachor of the solute was also determined. The various values were then plotted against the concentration of lead nitrate. All curves indicate three breaks at concentrations corresponding to the compounds:  $4\text{KNO}_3 \cdot \text{Pb}(\text{NO}_3)_2$ ,  $2\text{KNO}_3 \cdot \text{Pb}(\text{NO}_3)_2$  and  $\text{KNO}_3 \cdot \text{Pb}(\text{NO}_3)_2$ . Of these only the second had been known before.

#### 20. Formation of Complex Compounds between Lead Nitrate and Alkali Nitrates: Part II. The System: $\text{Pb}(\text{NO}_3)_2 - \text{NaNO}_3 - \text{H}_2\text{O}$ .

M. R. NAYAR and C. S. PANDE, Lucknow.

Exactly similar procedure was adopted as explained in Part I. The properties investigated were density, conductivity and viscosity. All the plots were regular without any breaks, which were interpreted to mean that the tendency for the formation of complex compounds between these two salts is practically nil.

#### 21. Formation of Complex Compounds between Lead Nitrate and Alkali Nitrates: Part III. The System: $\text{Pb}(\text{NO}_3)_2 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}$ .

M. R. NAYAR and C. S. PANDE, Lucknow.

The difference in behaviour of potassium and sodium nitrates in the formation of complex compounds with lead nitrate led us to study the system:  $\text{Pb}(\text{NO}_3)_2 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}$ . G. Malquori (*Atti., R. Accad. Lincei.*, 1929(6), 9, 231 and *Gazzetta* 1929, 359, 355), from measurements of conductance and viscosity of solutions of lead nitrate, of ammonium nitrate and of mixtures of these two salts between  $15^\circ$  and  $60^\circ$ , adduced evidence for the formation of one complex of the type:  $2\text{NH}_4\text{NO}_3 \cdot \text{Pb}(\text{NO}_3)_2$ .

Thus only one compound was known but our results indicate that there are at least three definite compounds, analogous to the potassium salts.

Exactly similar procedure was adopted as explained in Part I of this paper. The results obtained are unlike those of  $\text{NaNO}_3$  but very much like those of  $\text{KNO}_3$ . Three breaks in the curves at concentrations corresponding to 5 cc., 10 cc., 20 cc., of  $\text{Pb}(\text{NO}_3)_2$  are obtained. The molecular ratios between  $\text{NH}_4\text{NO}_3$  and  $\text{Pb}(\text{NO}_3)_2$  at these points correspond to the compounds,  $4\text{NH}_4\text{NO}_3 \cdot \text{Pb}(\text{NO}_3)_2$ ,  $2\text{NH}_4\text{NO}_3 \cdot \text{Pb}(\text{NO}_3)_2$  and  $\text{NH}_4\text{NO}_3 \cdot \text{Pb}(\text{NO}_3)_2$ .

#### 22. Alternating Current Electrolysis of Silver Nitrate Solutions with platinum Electrodes.

A. N. KAPPANNA and K. M. JOSHI, Nagpur.

Electrolytic experiments done with 0.1N silver nitrate solutions, using platinum electrodes and a.c. frequencies 10, 20, 30 and 40 have been recorded. The current efficiency

as measured by the total amount of silver deposited on both the electrodes varies with time at the same frequency of a.c. It increases at first with time, reaches a maximum and then falls off. At the same current density when the current is passed for the same time, the current efficiency does not vary with increase in frequency over the range examined.

Over the range of frequencies examined, it appears that one of the electrodes functions as the anode and the other as the cathode. The product on one of the electrodes is black and spongy, while that on the other is silver-white. The black deposit when dissolved evolves plenty of oxygen and has been identified to be peroxy-nitrate. When deposited on fresh platinum electrodes, and the two electrodes in the silver nitrate solution connected to the terminals of a voltmeter show a voltage of 0.675 volts, the peroxy-nitrate electrode being the positive. Direct current electrolysis of the same solution on the same electrodes gave products yielding the same voltage. The voltage remains steady for quite a few minutes if the solution is kept stirred, but falls off rapidly if stirring be stopped. These experimental results have been discussed.

### 23. Conductivities of Calcium Gluconate Solutions.

A. N. KAPPANNA and INDRA DEVA ARYA, Nagpur.

Conductivities of calcium gluconate solutions in water have been measured in the range of low concentrations and at different temperatures between 25° and 60°C. Viscosities of these solutions have also been measured. The results are discussed in the light of modern theories.

### 24. Reaction between Benzene and Nitric Acid.

A. N. KAPPANNA and S. N. BEHERE, Nagpur.

The work was undertaken as a preliminary to the study of the action of certain materials as catalysts in the nitration process with particular reference to mononitration. The influence of concentration of nitric acid, temperature, quantity of nitric acid/quantity of benzene ratio on the yield of nitrobenzene have been investigated. The addition of nitrobenzene to the reaction mixture at the start does not influence either the rate or the yield of nitrobenzene. Neither does it, as was pointed by some previous workers, influence the extent of reaction by acting as a dehydrant. The addition of mercuric nitrate in small quantities accelerates the reaction producing mononitrobenzene—larger quantities of the catalyst promote the formation of higher nitration products.

### 25. Adiabatic Compressibility of Liquids.

M. RAMA RAO, Madras.

The velocity of sound in a liquid is related to the adiabatic compressibility  $\beta\phi$  and density  $\rho$  of the liquid by the relation  $v = 1/\sqrt{\beta\phi\rho}$ . Combining this with the relation between the velocity of sound  $v$  in liquids and molecular volume  $V$ , namely  $v_1 V = R$  it follows that  $\beta\phi V = \text{constant}$ , independent of temperature and dependent on the liquid. The above relation is found to hold good with remarkable accuracy for a number of normal liquids. Since the variation of density with temperature is represented by the equation  $\rho = \rho_0 \left\{ 1 - \frac{\Theta}{\Theta_c} \right\}^{3/10}$  it follows that the law for the variation of adiabatic compressibility with temperature is  $\beta\phi = \beta\phi_0 \left\{ 1 - \frac{\Theta}{\Theta_c} \right\}^{-2.1}$ . Here  $\Theta$  denotes the temperature and  $\Theta_c$  the critical temperature both on the absolute scale of temperature. The values of  $\Theta_c$  calculated from the above relation are found to be in good agreement with observed values. An attempt is made to explain the above relation starting from well-known equations of state for the liquid and using Maxwell's thermodynamic relations.

### 26. Velocity of Sound in Liquids and Molecular Volume: Part I.

M. RAMA RAO, Madras.

The velocity of sound in liquids is related to its molecular volume  $V$  by the simple relation  $v_1 V = \text{constant}$  independent of temperature and dependent entirely on the nature of the liquid. The new physical constant denoted by  $R$  has certain interesting properties. It is found that  $R$  is an additive function of the chemical composition, the changes in  $R$  between successive members of a homologous series being a constant and independent of the type of compound. As in the case of the parachor it is found possible to assign a definite contribution to  $R$  by each kind of atom and by double and triple bonds or a ring of atoms whatever be the nature of the atoms which are joined by the multiple bonds and included in the ring. The law for mixtures

$$R_{12} = R_1 x + R_2 (1-x)$$



where  $R_1$  and  $R_2$  are the values of  $R$  for the solute and solvent and  $R_{12}$  that of the mixture and  $x$  the molar fraction of the solute is found to hold good also. Thus the velocity of sound in liquids which is easily determined in the laboratory is used for the elucidation of chemical constitution of substances.

## 27. Velocity of Sound in Liquids and Molecular Volume: Part II.

M. RAMA RAO, Madras.

The new physical constant  $R$  relating the velocity of sound in liquids and molecular volume is found to bear a fairly constant ratio to the molecular critical volume  $V_c$ . A further analysis leads to the conclusion that  $R$  is related to the critical temperature, molecular weight and critical volume by the simple relation

$$R = \alpha \left( \frac{\Theta_c}{M} \right)^{\frac{1}{3}} V_c$$

where  $\alpha$  is independent of the liquid having an average value of 2.68 in the case of 20 liquids examined. It is also shown that  $R$  is related to the constants of energy  $\phi_0$  and length  $\gamma_0$  characteristic of the molecule in the inter-molecular potential used by Lennard-Jones and his collaborators by the relation

$$R = \delta \left( \frac{\phi_0}{M} \right)^{\frac{1}{3}} V_0^{\frac{1}{3}}$$

The mean value of  $\delta$  is found to be 1.69. From the interpretation of  $V_0^{\frac{1}{3}}$  as collision volume one would expect  $R$  to be additive when more complicated molecules are built

up since the variations in  $\left( \frac{\phi_0}{M} \right)^{\frac{1}{3}}$  are generally small.

## 28. Velocity of Sound in Liquids and Molecular Association, Part III.

M. RAMA RAO, Madras.

A number of physical properties such as vapour pressure surface tension, the mole refraction and viscosity are used as evidence of molecular association in liquids. For the majority of liquids it is noticed that many of these physical properties obeyed at least roughly certain empirical rules. The velocity of sound in liquids has not so far been studied as a criteria for molecular association in liquids. It is found that while  $R$  remains fairly constant for normal liquids it is found to vary with temperature for the so-called

associated liquids. Lagemann has studied the relation  $\frac{P_c R}{\Theta_c} = K$  where  $P_c$  is the critical pressure and  $\Theta_c$  the critical temperature and  $R$  is the constant defined above as evidence for molecular association in liquids. If we now substitute the value of  $R$  we have found in terms of critical volume and critical temperature we find that  $K$  will be equal to  $\alpha \left( \frac{\Theta_c}{M} \right)^{\frac{1}{3}}$

$\times \frac{P_c V_c}{\Theta_c}$  and  $\frac{P_c V_c}{\Theta_c}$  is a universal constant and so the criteria reduces to the value of  $\left( \frac{\Theta_c}{M} \right)^{\frac{1}{3}}$  being a constant for most non-associated liquids.

The advantage of the velocity of sound criteria for association in liquids over some others like surface tension is that the velocity of sound is a bulk property and is independent of measurements connected with the surface where unusual surface effects are built up. There are other limitations and these are discussed.

## 29. The Interaction of Iodine and Starch, Part II. Iodide Ions in the Complex.

S. MUKHERJEE and S. BHATTACHARYA, Calcutta.

The variation of the ratio of  $I'/I_2$  in starch-I and amylose-iodine complexes with the concentration of KI in the solutions from which they are precipitated have been investigated. For an increase of KI concentration from 0.046 M to 1.210 M, the ratio of  $I'/I_2$  in potato starch iodine complex increased from 0.125 to 0.329 and that in amylose-iodine complex from 0.141 to 0.474. This maximum ratio found for the amylose-iodine complex corresponds to that required for the formation of the  $I_3^-$  ion.

Prolonged washing of the starch iodine complex with  $Na_2SO_4$  solution leads to the partial removal of both  $I^-$  ions and  $I_2$  molecules.

## 30. Kinetics of Consecutive Reactions: Hydrolysis of Nitriles.

G. G. MUJUMDAR, K. K. DOLE and D. D. KARVE, Poona.

In continuation of the previous work on the hydrolysis of nitriles, it has been shown that the maximum concentration which is attained by the intermediate product during

the course of the reaction is dependent solely on the ratio  $k_1/k_2$  and not on the actual values of  $k_1$  and  $k_2$ . But the time at which this maximum concentration occurs is dependent both on the ratio and the actual values of  $k_1$  and  $k_2$ .

The relative temperature effect on the two sub-reactions involved can be easily found out by studying the maximum concentration at any two temperatures. If the maximum concentration has a greater value at the higher temperature, then it may be inferred that the first sub-reaction is more sensitive to temperature.

A curve has been plotted with different values of the ratio  $k_1/k_2$  against the corresponding maximum concentrations attained by the intermediate product. This curve enables one to calculate either  $k_1$  or  $k_2$ .

A third interesting observation is that the calculations (of the velocity constant,  $K'$  carried out with  $x$ =the intermediate product, show that the earlier values of  $K'$  are nearly equal to the velocity constant  $k_1$  of the first sub-reaction. The values of  $K'$  then go on decreasing markedly.

### 31. Dielectric Constants and Dipole Moments.

S. K. K. JATKAR and B. R. Y. IYENGAR, Bangalore.

In continuation of previous work [Jatkar, *Nature*, 153, 222 (1944); Jatkar, Iyengar and Sathe, *Journal of Indian Institute of Science*, Vol. 28A, Part II-I (1946)], the most general and extraordinarily simple relationship between dielectric constant and dipole

moment has been found to be 
$$\left(\frac{\epsilon - \epsilon_0}{\epsilon_0}\right) \frac{M}{d} = 4\pi N \frac{\mu^2}{3KT} \left(\frac{g+1}{g}\right) \quad \text{where } g = \infty$$

for gases and  $g = \frac{1}{2}$  for solids and liquids. The theoretical derivation of this equation follows from the considerations of quantised orientations similar to those applied in magnetic case with its attendant repercussions. These are also inherent in previous theories of hindered rotation, parallel and anti-parallel orientations postulated by Debye. The experimental verification of the previous theories of Debye and Onsager in the case of dilute solutions and pure liquids respectively has been shown to be due to *remarkable and fortuitous coincidence*, which arises from the fact that their equations arithmetically approximate to the correct relationship given above. The theories of Kirkwood and Frölich require the evaluation of *undesirable and inaccurate* parameters. Even the limited applicability of Frölich and Sack's equation, which contained two parameters, was pointed out as being due to an arithmetical error in calculation (cf. *Proc. Roy. Soc., A185*, 399, 1946).

The experimental data on the dielectric constant of a vast number of molecular and ionic (above  $\lambda$  point) solids, plastics, liquid crystals, normal and associated liquids, and solutions of both polar and non-polar solvents, fully support the above relationship.

### 32. Dipole Moment of Hydrogen Halides.

S. K. K. JATKAR and (Miss) S. B. KULKARNI, Bangalore.

High dielectric constants of hydrogen chloride, bromide and iodide in solid state indicate rotation of the molecules. The new equation is employed to calculate the moments of the molecules in solid state. The moments of hydrogen chloride, bromide and iodide for pure solid, liquid and also in solution form are in full agreement with their gas values. The higher solution values reported in literature are due to the application of the now incorrect D. C. M. equation. The ionic character for HF, HCl, HBr and HI have been found to be 0.4, 0.2, 0.1 and 0.05 Debye units respectively.

### 33. Configuration of Mercury Halides.

S. K. K. JATKAR and (Miss) S. B. KULKARNI, Bangalore.

Spectroscopic data indicate a linear structure for mercuric chloride, bromide and iodide. As they have centres of symmetry these compounds should be non-polar according to the old conception of the theory of dipole moments. These substances however show dipole moments in solutions. The moments of these halides in pure solid form as well as in dioxane solution calculated by applying the new equation are 1.14 for  $\text{HgCl}_2$ , 1.46 for  $\text{HgBr}_2$  in solution, 1.19 for  $\text{HgI}_2$ . This indicates that these compounds are ionised and the moment is due to the resonance structure and not due to the non-linear structure as was assumed by the previous authors. The ionic nature for different compounds is calculated.

### 34. Electric Moments of Chloro- and Iodo-Derivatives of 8-Hydroxy-quinolines.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

The dipole moment of 8-hydroxyquinoline in pure liquid form and that of its chloro-iodo derivatives in benzene solutions has been determined. The moment of 8-hydroxyquinoline is 2.28 D for both pure substance and in solution. Those of 5-iodo-7-chloro-, 5-chloro-7-iodo-, 5 : 7-dichloro and 5 : 7-diiodo-8-hydroxyquinoline are 3.2, 2.1, 4.2 and 6.4 Debye units respectively.

### 35. Moments of *o*-, *m*-, and *p*-Aminobenzoic Acids and Their Esters.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

Dielectric constants of *o*-, *m*-, *p*-aminobenzoic acids in dioxane and of their esters in benzene have been studied and the respective electric moment calculated by applying the new equation. *o*-, *m*- and *p*-aminobenzoic acids give a moment of 1.2, 2.3 and 2.8 D respectively while the corresponding methyl esters have a moment of 0.9, 2.1 and 2.7 D respectively.

### 36. Dielectric Properties of Triglycerides.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

Dielectric properties of tristearin, tripalmitin, triolein in pure liquid form as well as in benzene and cyclohexane solutions have been investigated and the electric moments calculated by applying the new equation. Tristearin in pure form as well as in dioxane and benzene gives a moment of  $2.7 \times 10^{-18}$  C. G. S. units. The moment of tripalmitin in pure liquid form is 2.05 and in benzene solution 2.15. Liquid triolein shows a temperature effect the moment varying from 1.9 to 2.7 D units.

### 37. Dipole Moments of Some Flexible Molecules.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

Dielectric constants of some flexible molecules like hydroquinone dialkyl ethers, catechol dialkyl ethers and resorcinol dialkyl ethers in pure liquid form have been measured and the data used to calculate the electric moments. The recalculated solution data of the same compounds agree with the results obtained by the authors for pure liquids. Results are interpreted as indicating free rotation of the bonds, along the O-R groups, where R stands for the methyl or ethyl group.

### 38. Dipole Moments of DDT and Related Compounds.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

Dielectric constant of DDT (*p* : *p*-dichlorodiphenyltrichloroethane) in pure liquid form and also in benzene and carbon tetrachloride solutions has been measured, and the dipole moment calculated by applying the new equation. Also the moments of dehydrochlorinated DDT and eleven other related compounds of DDT have been calculated. Taking the bond moments C-H 0.42, C-Cl 1.69, the calculated dipole moment of DDT is 0.98, which agrees with the experimental value 1.0. Dehydrochlorinated compound is non-polar as it should be according to the structural formula  $(C_6H_4Cl)_2C=CCl_2$ . The moment of *o* : *p*-DDT is highest, *p* : *p'*-DDT is least and *m* : *p'*-DDT is intermediate.

### 39. The Dielectric Constant and Dipole Moment of Halides of Phosphorus, Arsenic, Antimony, SO<sub>2</sub>, SO<sub>2</sub>Cl<sub>2</sub>, SOCl<sub>2</sub>, POCl<sub>3</sub>, and PSCl<sub>3</sub>.

S. K. K. JATKAR *and* S. N. GOPALASWAMY, Bangalore.

The dielectric constants of halides of phosphorous, arsenic and antimony and of their solutions in benzene, carbon disulphide and carbon tetrachloride and of sulphur dioxide, thionyl chloride, sulphuryl chloride, phosphorous oxychloride, and PSCl<sub>3</sub> have been used to calculate dipole moments by the new equation. The results have been compared with those obtained by Bottchar using Onsager's formula. The ionic character of the bonds are discussed in light of Pauling's theory of electronegativity.

40. Dipole Moments of *p*-Benzidine, Indole, Carbazole, Naphthylamine, Camphorquinone and Dimethyldihydroresorcin.

S. K. K. JATKAR and (Miss) S. B. KULKARNI, Bangalore.

The dielectric constants of the above compounds have been measured at different temperatures and the dipole moments calculated by applying the new equation. The moment of *p*-benzidine is 1.7 and corresponds to the moment of hydrazine. The moment of both indole and carbazole is 1.7. Naphthylamine moment is 1.7. Camphorquinone in benzene gives a moment of 3.9 which is a vector of two C-O groups making an angle of  $36^\circ$  with each other. The moment of 4.5 for dimethyldihydroresorcin indicates a chair-form of cyclohexane ring.

41. Moments of Some Symmetrical Molecules.

S. K. K. JATKAR and (Miss) S. B. KULKARNI, Bangalore.

The dielectric properties of *p*-quinone, *p*-dinitrobenzene, symmetrical trinitro-benzene and trinitro-mesitylene are studied. These compounds have centres of symmetry and should be non-polar. But these molecules do possess a small moment. *p*-quinone gives a moment of 0.6 unit in different solvents as well as in pure form. *p*-Dinitrobenzene and *s*-trinitro-benzene and mesitylene possess a moment of 0.6 unit, independent of concentration, but in polar solvents, like chloroform, these molecules are non-polar which is due to the hindered rotation, while in non-polar solvents like benzene, carbon tetrachloride, etc., the rotation is not hindered and the small moment is due to free rotation of the groups.

42. Dielectric Properties of Compounds forming Intermolecular and Intramolecular Hydrogen Bonding.

S. K. K. JATKAR and (Miss) S. B. KULKARNI, Bangalore.

Organic compounds form three types of hydrogen bonds: (1) Intermolecular bond resulting into unlimited association to form chain-like molecules as in alcohols; (2) Intermolecular bond forming definite dimers as in carboxylic acids and (3) Intramolecular bonds formed by the strong chelation of electronegative substituents in close proximity to the hydrogen atom. Pure primary alcohols according to the new equation have a moment of  $2.6 \times 10^{-18}$  C. G. S. units, while the values for the same solution are in about  $1.6 \times 10^{-18}$ . In the case of secondary alcohols the difference between the solution value and the pure value is between 0.6 and 0.8. In tertiary butyl and amyl alcohols, the moments are the same for pure liquids and solutions, as the intermolecular bondary is prevented due to steric hindrance. This view is supported by the spectroscopic examination of the compounds. The moment 3.1 for *o*-nitrophenol is in full agreement with the rigid structure on account of chelation and hence is a vector of  $\text{NO}_2$  moment 4.2, C-D 1.75 and O-H 2.5. The moment of benzoin obtained from the dielectric constant is 3.36 which is explained by its rigid structure for the molecule due to the formation of intramolecular bond. Guaiacol Salicyl aldehyde, *o*-hydroxyacetophenone, *o*-hydroxybenzyl alcohol, are shown to form intramolecular hydrogen bond and the structures are proved to be rigid due to the formation of O-H ... O bonding.

43. Dipole Moments of Cyanides.

S. K. K. JATKAR and B. R. Y. IYENGAR, Bangalore.

The new relationship has been applied to the dielectric constant data of pure hydrogen cyanide and acetonitrile and of dilute solutions in non-polar solvents of hydrogen cyanide, aceto-, propio-, butyro-, benzo- and succino-nitriles, to calculate dipole moments. The latter have been compared with vapour values and quantitatively explained in light of molecular structures.

44. Dipole Moments of Phenol, Substituted Phenols and Naphthols.

S. K. K. JATKAR and (Miss) S. B. KULKARNI, Bangalore.

The dipole moments of phenol, catechol, resorcinol, hydroquinone and *o*, *m*, *p*-chlorophenols have been studied from the point of view of intermolecular and intramolecular hydrogen bond formation. The moment of phenol in benzene solution according to the new equation is 1.4 while the pure substance gives different values at different temperatures. Catechol in benzene gives a moment of 2.2 corresponding to free rotation value along OH, which shows that there is intramolecular bond OH- ... O. Resorcinol in pure

form gives a moment of 2.8 which is a vector moment and in benzene the value of 1.68 corresponds to free rotation along the C-O bond. The moment of hydroquinone in benzene is 1.4 which is an average of ustrans planer structures. The moment of 1.45 for *o*-chlorophenol corresponds to the rigid structure due to the formation of OH-...Cl bond. *p*-Chlorophenol has a moment of 2.1 agreeing with the calculated value. The dipole moment of the *meta*-compound is 1.79. The moments of *α*- and *β*-naphthols are 1.5 and 1.67 D respectively.

#### 45. Dielectric Properties of Some Esters, Ethers, Ketones.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

The dipole moments of esters, ethers, ketones, *o*- and *p*-nitroanilines are calculated by applying the new equation for pure liquids and solids. For methyl, ethyl, butyl acetates the moment is 1.45, the moment for the corresponding benzoates being 1.7. For diethyl malonate it is 2.2. Anisol, phenetol and diethyl ethers give a moment of 1.1 each. The moment of ethylmethylketone and acetophenone is 2.8 and that of benzophenone 3.1.

#### 46. Dipole Moments of Higher Fatty Acids.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

The dielectric constants of stearic, palmitic, oleic and linolic acids in pure form have been determined and the electric moments calculated by applying the new equation. The solution data for the acids mentioned above is also recalculated. It is observed that the moments of acids go on increasing with temperature as the associated double molecules are split up into single molecules at higher temperatures. The same is true in the case of the binary mixtures of these acids with hydrocarbons like benzene, cyclohexane, etc., the moment decreasing with the concentration, but in dioxane solution the molecules are no longer present as double molecules but only as single molecules and the moment which is independent of concentration corresponds to the correct value.

#### 47. Dielectric Properties of Salicylates.

S. K. K. JATKAR *and* (Miss) S. B. KULKARNI, Bangalore.

Dielectric constants of pure ethyl, methyl and phenyl salicylates have been studied and the moments calculated by applying the new equation, are 2.05, 2.19 and 2.20 as contrasted with the values of 2.4, 2.88, 3.15 respectively reported in literature due to the application of incorrect D. C. M. equation to solutions. These compounds form intra-molecular hydrogen bonds OH-...O. The three compounds should have about the same moment.

#### 48. Free Energy of the Reaction $2 \text{CH}_3\text{OH} \rightleftharpoons (\text{CH}_3)_2\text{O} + \text{H}_2\text{O}$ .

S. K. K. JATKAR *and* D. LAXMINARAYANAN, Bangalore.

The variation of the equilibrium constant of the above reaction has been measured by Jatkar *et al* and by Mackie and Burke. The specific heats of the reactants and resultants as calculated from spectroscopic data showed that  $C_p$  for this reaction is positive, hence  $\log K_p$  cannot be a linear function of  $1/T$ . The results of Mackie and Burke are however found to be too low. Unfortunately, the specific heat of methyl alcohol cannot be calculated by the usual statistical method owing to hindered potential of the rotation of OH group. A knowledge of the equilibrium constants of the above reaction should enable one to calculate this hindered potential.

#### 49. Polarograph.

S. K. K. JATKAR *and* K. S. RAMASWAMY, Bangalore.

A simple polarograph has been constructed using several novel features either for hand recording or photographing the current potential curves. The current has been more accurately measured by an auxiliary drum type potentiometer using a cheap sensitive galvanometer as a null instrument.

#### 50. Coagulation of Colloids by Bi-Metallic Junctions.

P. B. GANGULY *and* P. P. GYANI, Patna.

The coagulation of  $\text{As}_2\text{S}_3$ ,  $\text{V}_2\text{O}_5$ ,  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  sols by Mg-Fe, Mg-Mn, Mg-Zn, Mg-Cu, and Mg-Ag couples has been studied in detail. Traces of couple metals have

been detected invariably either in the supernatant liquid or in the coagulum or in both after complete coagulation of the sol. Active hydrogen evolved by the action of couples on the sols has been shown to be an important factor in such coagulation. Measurements have been made of the time of coagulation and of the volume of hydrogen evolved during that time. Minimum coagulation voltage for the above sols have been determined.

It has been shown that the junction potential of the couples is not the predominant factor in such coagulation. The effect of electrolytes formed has been discussed. It has been shown that Hardy-Schulze Law is not apparently obeyed. Possible explanations for the enhanced coagulation of colloids by active hydrogen have been suggested.

## 51. Nature of Sorption.

K. SUBBA RAO, Bangalore.

By an extensive study, employing the retentivity technique, Allmand and collaborators have reported that sorption isotherm is discontinuous and is made up of a series of breaks (Allmand and Burrage. *Proc. Roy. Soc. A.* 610, 1931., *J. Phys. Chem.* 1692, 1931). By modified technique, flushing and heat-treatment of the adsorbent, Foster fails to get any discontinuity (Foster. *Trans. Faraday. Soc.* 1559, 1936). In a recent paper, the theoretical significance of this vexed problem of discontinuous nature of sorption—a problem of fundamental importance—has been discussed by the author in the light of the cavity concept (Rao. K. S. and V. R. Thiruvengatachar, *Current Science*, 103, 1946). To investigate the reality of the discontinuous nature of sorption, sorption of water vapour on silica gel was studied. The quartz fibre spring technique was employed in the experiments. Points on the isotherm as close as 15 per m.m. pressure were taken. There is no perceptible discontinuity. Elucidation of the fine structure of sorption isotherm necessitates measurement of sorption at still smaller increments of pressure with higher accuracy of the technique. Experiments are in progress.

## 52. Physical Properties of Isomeric Oximes.

N. K. PATWARDHAN, Indore.

Solutions of aldioximes and ketoximes in liquid sulphur dioxide gave measurable conductivities. The  $\beta$ -aldioximes in all cases gave higher conductivities than  $\alpha$ -aldioximes. Hence by extension of Ostwald's rule regarding ethylenic acids to the aldioximes the  $\beta$  forms should have "anti"-configurations and the  $\alpha$ -forms should be "syn." Similarly that ketoxime which is "syn" with respect to the more negative group (out of the groups attached to the carbon atom in the ketone) will be a stronger acid than its isomer and hence would give a higher conductivity. This has been found to be so. These new configurations are in agreement with those suggested by Beckmann, Meisenheimer and others and opposite to those originally given by Hantzsch.

The isomeric aldioximes and ketoximes give different values of parachors. Generally, in a pair of aldioximes or ketoximes those having higher electrical conductivity give higher values of parachor. Consequently in aldioximes this indicates an "anti" configuration and in the ketoximes the presence of the negative group in the vicinity of the oxime hydroxyl group. Provided a suitable (0.2) molar fraction is reached, oximes of low conductivity give parachor values agreeing with those calculated from the formula, while oximes of higher conductivity give values higher than the calculated values.

## Organic Chemistry

### 53. Condensation of Salicylaldehyde with Malonic Acid—giving Dihydro-coumarin-4-malonic and other Acids.

KANTILAL C. PANDYA and RAGHUNATH SINGH, Agra.

This old reaction studied first in this laboratory by Surange and Pandya in 1929-1930, and by Kurien and Pandya in 1930-1931, has been reinvestigated. An acid that had then escaped notice has now been isolated and found to be 3:4-dihydro-coumarin-4-malonic acid. This acid on melting passes into the corresponding 3:4-dihydro-coumarin-4-acetic acid. It is also suspected that a very small trace of another acid, not prepared so far, salicylidene-malonic acid, is also obtained, though some analytical confirmation has still to be obtained of its identity.

### 54. Synthetic Anthelmintics: Synthesis of 7-5-alkyl-2:4-dimethoxyphenyl butyrolactones.

K. R. IRANI, N. L. PHALNIKAR and K. S. NARGUND, Poona.

Dimethyl ethers of 4-alkyl resorcinols ( $R = C_2H_5$ ,  $nC_3H_7$ ,  $nC_4H_9$ ,  $nC_6H_{13}$ ) have been prepared and condensed with succinic anhydride to obtain the corresponding

2 : 4-dimethoxy-5-alkyl-benzoylpropionic acids, the constitution of which was proved by oxidation. On reduction and lactonisation these keto-acids gave  $\gamma$ -2 : 4-dimethoxy-5-alkyl-phenyl butyrolactones which are being tested for their anthelmintic properties.

#### 55. Synthetic Anthelmintics : Synthesis of $\gamma$ -2 : 4-Dialkoxy-Phenyl Butyrolactones.

K. R. IRANI, N. L. PHALNIKAR and K. S. NARGUND, Poona.

$\beta$ -2 : 4-Dialkoxy-benzoylpropionic acids ( $R = C_2H_5$ ,  $nC_6H_7$ ,  $nC_4H_9$ ,  $iso-C_5H_{11}$ ) have been obtained by the condensation of resorcinol dialkyl ethers and succinic anhydride in the presence of anhydrous aluminium chloride using nitrobenzene as solvent. These keto-acids were reduced with sodium and alcohol and were lactonised with sulphuric acid to the corresponding  $\gamma$ -2 : 4-dialkoxy-phenyl-butyrolactones which are being tested for their anthelmintic properties.

#### 56. Synthetic Anthelmintics : Synthesis of $\gamma$ -5-alkyl-2-methoxyphenyl Butyrolactones.

K. R. IRANI, N. L. PHALNIKAR and K. S. NARGUND, Poona.

*p*-Alkylanisoles (alkyl group = *n*-Pr, *n*-Bu, *n*-Amyl, *n*-hexyl, *n*-heptyl) on condensation with succinic anhydride in the presence of anhydrous aluminium chloride gave  $\beta$ -2-methoxy-5-alkyl-benzoylpropionic acids which have been characterised by suitable derivatives. The constitution of these acids has been proved by oxidation. These keto-acids on reduction with sodium and alcohol followed by lactonisation gave  $\gamma$ -2-methoxy-5-alkyl-phenyl-butyrolactones, which are being tested for their anthelmintic property.

#### 57. Synthetic Anthelmintics : Synthesis of $\gamma$ -3-alkyl-4-methoxyphenyl Butyrolactones.

K. R. IRANI, N. L. PHALNIKAR and K. S. NARGUND, Poona.

*o*-Alkylanisoles have been condensed with succinic anhydride in the presence of aluminium chloride (anhydrous) using nitrobenzene as solvent, when  $\beta$ -3-alkyl-4-methoxy-benzoylpropionic acids were obtained. These keto-acids have been characterised by suitable derivatives and their constitutions were proved by oxidation. The keto-acids were reduced and lactonised to the corresponding  $\gamma$ -3-alkyl-4-methoxyphenylbutyrolactones which are likely to prove good as anthelmintics.

#### 58. Halogenation. Part XXXIX. Direct Iodination of Aromatic Ketones.

P. S. VARMA and S. VARMA, Benares.

Iodo-derivatives of aromatic ketones have generally been obtained before by indirect methods. Attempts have been made to iodinate them by direct methods. It has been possible to obtain by direct iodination iodo-derivatives of acetophenone, *p*-methylacetophenone, *p*-chlor-acetophenone, *p*-brom-acetophenone, benzophenone, *p*-hydroxybenzophenone and  $\alpha$ -naphthyl methyl ketone by the methods of Varma and Panicker (J. I. C. S. 1926, 3, 342).

#### 59. Halogenation. Part XXXX. Iodination of Aromatic Nitrohydrocarbons.

P. S. VARMA and B. C. MATHUR, Benares.

In a previous paper (Halogenation. Part XXXVI) it was stated that nitro-hydrocarbons could be directly iodinated to nitro-iodo-compounds. Nitro-naphthalene, nitro-cymene, 1-nitro-2-methyl naphthalene, dinitro-benzene, chloro-dinitro-benzene, *p*-nitro-bromo-benzene, dinitrotoluene have now been iodinated and the corresponding iodo-nitro-compounds obtained.

#### 60. Condensation of Diphenyl Ether and Diphenyl Thioether with Arsenic Trichloride.

P. S. VARMA and S. A. SUBRAMANIAN, Benares.

Diphenyl ether has been condensed with arsenic trichloride in presence of a large number of condensing agents and a very good yield of 6-chloro-phenoarsazine has been obtained. Similarly diphenyl thioether gives an almost quantitative yield of 6-chloro-phenthioarsazine.

61. Studies on the mechanism of Colour Reactions for Steroids. Part I. Action of  $\text{H}_2\text{SO}_4$  on Cholesterol in Acetic Acid Solution.

M. C. NATH and M. K. CHAKRABORTY, Nagpur.

By the action of concentrated sulphuric acid on glacial acetic acid solution of cholesterol an acetic acid insoluble product was obtained, which on further fractionation gave one ether-insoluble and two ether-soluble products.

These substances were identified as  $\alpha$ - $\beta$ - and  $\gamma$ -cholesteriline of Maubner and Suida who prepared them by the action of 66% sulphuric acid on solid cholesterol.

From the glacial acetic acid soluble part of the reaction product a substance was isolated, which was identical with cholesteryl acetate.

The influence of time and concentration of sulphuric acid on the formation of all these substances was also studied.

62. Studies on the Colour Reactions for Steroids. Part II. Isolation of the products of the new ring reaction.

M. C. NATH and G. R. DEBNATH, Nagpur.

Attempts were made to find out the mechanism of the new sensitive ring-test for steroids, which consists of layering with conc.  $\text{H}_2\text{SO}_4$  and acetic acid solution of steroids, to which one drop of 1% acetic acid solution of mercuric acetate has already been added.

Among the reaction products  $\alpha$ -,  $\beta$ -, and  $\gamma$ -cholesteriline and cholesteryl acetate were obtained.

63. Studies on the Rosenheim Reaction. Action of Rosenheim Reagent on Cholesterol.

M. C. NATH and R. C. ROY, Nagpur and Dacca.

Reaction products formed in the course of Rosenheim reaction with cholesterol at a higher temperature have been isolated and studied. Cholesterol when treated with Rosenheim's reagent takes up the trichloroacetyl group in place of the hydroxyl group at  $\text{C}_3$  thus giving rise to Cholesteryl trichloroacetate ( $\text{C}_{29}\text{H}_{45}\text{O}_2\text{Cl}_3$ ). This chloro-compound on prolonged treatment with the reagent is transformed into a hydrocarbon of the cholesterilene series ( $\text{C}_{27}\text{H}_{44}$ ), thus showing that the chloro-compound is the intermediate product formed during the course of the reaction.

64. Quinoline Derivatives.

T. N. GHOSH, Calcutta.

According to Payne (*Lancet*, 1945, i, 206) and other clinicians, the incidence of amebiasis is surprisingly high, the diagnosis often difficult and elusive, the treatment unsatisfactory and the relapse rate disappointing.

Derivatives of 8-hydroxyquinoline have been found to possess pronounced amebicidal properties and are often used with success in the treatment of chronic cases of amebic dysentery. However, of all the drugs so far known none provides a guaranteed cure and there is, therefore, abundant need to discover a more potent and dependable amebicidal drug. In view of the recent observations on the activity of various amidine derivatives against parasitic diseases (Trypanosomes, Malaria, etc.), it has been considered desirable to prepare a derivative of 8-hydroxyquinoline containing an amidino-group. Such a compound is expected to possess pronounced amebicidal property. 5-Amino-8-ethoxyquinoline has been converted successively into 5-cyano-8-ethoxyquinoline and 8-ethoxyquinoline-5-amidine.

65. On Organo-arsenical Compounds, Part I.

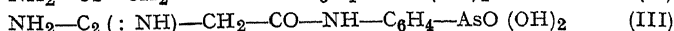
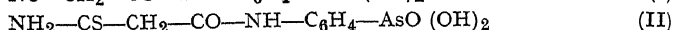
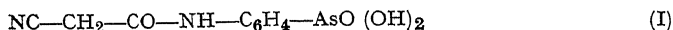
T. N. GHOSH, Calcutta.

In recent years several aromatic diamidines have been found to exhibit pronounced trypanocidal action. Amongst the derivatives of *p*-aminophenylarsonic acid so far prepared and tested, Tryparsamide, which contains  $-\text{CH}_2-\text{CO}-\text{NH}-$ grouping, has been found very effective against trypanosomes.

In search for a drug which would prove lethal to "arsenic-fast" trypanosomes and also effective in late cases, it has been considered desirable to prepare a phenyl arsonic acid which would embrace the above features, namely, both  $-\text{CH}_2-\text{CO}-\text{NH}-$  and amidino



groups. Accordingly *p*-cyanoacetyl-amino-phenylarsonic acid (I) was prepared by condensing *p*-arsanilic acid with ethyl cyanoacetate. The thioamide (II), and the amidine derivative (III) have been obtained from (I).



## 66. Synthesis of *p*-Aminodiphenylstibinic Acid.

T. N. GHOSH, Calcutta.

As a result of the researches of Ashley, *et al.* (*J. Chem. Soc.*, 1942, 103), Kirk and Sati (*Ann. Trop. Med. Parasitol.*, 1940, 34, 82), Adams and Yorke (*ibid.*, 1939, 33, 323; 1940, 34, 174) and other workers, several aromatic diamidines have been found to exhibit pronounced Trypanocidal action. Some of these diamidines have been successfully employed for the treatment of Mediterranean Kala-azar and of Indian Kala-azar.

Derivatives of *p*-aminodiphenylstibinic acid, such as, Urea Stibamine, diethylamine *p*-aminodiphenylstibinate, etc., have been found to be potent drugs for the treatment of Kala-azar. Although the former drug is widely used in India, it has two drawbacks namely, its variable composition and its instability. Moreover, it shows toxic reactions occasionally. In an attempt to obtain a compound with enhanced therapeutic activity and low toxicity for the treatment of Kala-azar, *p*-aminodiphenylstibinic acid has been synthesised.

## 66a. Studies in steroids.

PHANINDRA CHANDRA DUTTA, Calcutta.

Ethyl cyclohexylidene acetate is allowed to react with bromine. The dibromo-compound loses hydrobromic acid on treatment with sodium methoxide and the unsaturated bromo-ester reacts with methyl cyclopentanone carboxylic ester in presence of magnesium to give the corresponding hydroxy ester (160-65°/2 mm.) in a moderate yield. This is dehydrated with *p*-tolyl sulphonic acid to the doubly saturated compound (150-55°/2 mm.) which readily takes up two atoms of hydrogen giving the saturated compound (140-45°/2 mm.). This reacts smoothly with sodium dust to give the β ketonic ester (dirty-green ferric chloride coloration) which is hydrolysed to the tricyclic ketone (115°/4 mm.).

The acid-chloride of methylheptylacetic acid condenses with aceto-succinic ester and the crude condensation product on hydrolysis with dilute alkali gives the keto-acid which is isolated as its ethyl ester (126-30°/3 mm.). It reacts with methyl magnesium iodide to give the corresponding lactone (126-28°/4 mm.) which, when distilled over phosphorous pentoxide, gives the corresponding methylheptyl-methyl-cyclopentenone (126-30°/11 mm.). This is reduced with aluminium isopropoxide to alcohol (123°/7.5 mm.) which is dehydrated to the diene (110-12°/10 mm.) which passes over as a clear oil on distillation.

## 67. Dyes derived from Acenaphthenequinone. Part X. 2-(7-chloro)thionaphthene-acenaphthylene-indigos.

SISIR KUMA GUHA and JNANENDRA NATH CHATTERJEE, Patna.

Acenaphthenequinone and its 3-chloro-, 3-bromo-, and 1-methoxy-derivatives have been condensed with 7-chloro-3-hydroxythionaphthene (Dalglish and Mann, *J. C. S.* 1945, 893).

The new asymmetrical vat dyes are yellowish-red, red or darkish red crystalline products. Their dyeing shades on wool from a dilute sulphuric acid bath are quite uniform but not fully developed from substances derived from 3-chloro- and 3-bromo-acenaphthenequinone. They are lighter but more pleasing than the shades obtained from the 7'-chloro-compounds of the isatin series. The shades have also been developed well on cotton from an alkaline hydrosulphite vat except in the case of the methoxy derivative. (cf., Goldstein and Schlenker, *Helv. Chim. Acta.* 1921, 4, 334; Guha, *J. Indian Chem. Soc.* 1933, 10, 679; 1936, 13, 94; 1937, 14, 709; 1938, 15, 20; 1943, 20, 37). The colour of these 7-chloro dyes and their dyeing shades are lighter than those of the 5-chloro compounds (Guha, *J. Indian Chem. Soc.* 1939, 16, 127).

67a. Studies in the conessine series, Part IX. Degradation of N-tetramethyl-holarrhimine.

VISHWA NATH PURI, VISHWA NATH SHARMA and SALIMUZZAMAN SIDDIQUI, Delhi.

Distillation of N-tetramethyl-holarrhimine,  $C_{25}H_{44}N_2O \cdot C_{21}H_{31} \left\{ \begin{array}{l} N. Me_2 \\ N. Me_2 \\ OH \end{array} \right\}$  with zinc dust gives a crystalline base,  $C_{22}H_{36}NO$  (m.p.  $156^\circ$ ; hydrochloride, m.p.  $326^\circ$ ; picrate, m.p.  $267^\circ$ ; chloro-platinate, m.p.  $241^\circ$ ) in a yield of nearly 60%. It contains two N-methyls, as against four in N-tetramethyl-holarrhimine. Its nucleus, therefore, consists of only twenty carbon atoms in contrast to twenty-one present in conessine or any of its degradation products. This finding marks a definite advance in the knowledge about the extraordinarily stable  $C_{21}$ -carbo-cyclic nucleus of conessine in as much as it had not been possible so far to obtain a degradation product with a smaller number of carbon atoms, either with or without the elimination of both the basic nitrogen atoms present in the conessine series of alkaloids.

67b. Studies in the conessine series, Part X. Oxidation of N-tetramethyl-holarrhimine.

VISHWA NATH PURI, VISHWA NATH SHARMA and SALIMUZZAMAN SIDDIQUI, Delhi.

Oxidation of N-tetramethyl-holarrhimine,  $C_{25}H_{44}N_2O$ , with potassium iodate and dilute sulphuric acid yields, as in the case of conessine, a dioxy compound,  $C_{25}H_{46}N_2O_3$  (m.p.  $272^\circ$ ; hydrochloride, m.p.  $318^\circ$ ; hydroiodide, m.p.  $285^\circ$ ; chloro-platinate, m.p.  $239^\circ$ ) which does not contain the double bond originally present in the parent N-tetramethyl compound. The analytical data of the acetyl (m.p.  $122^\circ$ ) and the benzoyl derivatives (m.p.  $169^\circ$ ; hydrochloride, m.p.  $294^\circ$ ; chloro-platinate, m.p.  $254^\circ$ ) of this product show that it contains two additional hydroxyl groups. A small quantity of a water soluble base melting at  $309^\circ$  (hydrochloride, m.p.  $275^\circ$ ; chloro-platinate, m.p.  $244^\circ$ ) was also isolated.

67c. Studies in the conessine series, Part XI. Oxidation of dioxyconessine.

MOHAMMAD HAMEED KHALID, VISHWA NATH SHARMA and SALIMUZZAMAN SIDDIQUI, Delhi.

A number of workers (Giemsa and Habberkann, *Arch. Pharm.*, 1918, 256, 201) have attempted the degradation of dioxyconessine,  $C_{24}H_{42}N_2O_2$ , through oxidation with various oxidising agents or fusion with alkali but no well defined products could so far be obtained. Oxidation with dilute nitric acid has been found by the present authors to yield the crystalline nitrate (m.p.  $285^\circ$ , dec., yield ca. 40%) of an amphoteric base which is being further studied.

68. Indigoid Vat Dyes of the Isatin Series. Part VI. 3-Indole-2'-(7'-chloro)thionaphthene-indigos.

SISIR KUMAR GUHA and JNANENDRA NATH CHATTERJEE, Patna.

In Part V (Guha and Basu-Mallick, *J. Indian Chem. Soc.*, 1946, 23, 214) of this series the effect of a chlorine atom was studied when present in the 5'-position of the thionaphthene ring of 3-indole-2'-thionaphthene-indigos (Thioindigo Scarlet R and its substituted products).

The present investigation was undertaken with the object of studying the effect of a chlorine atom in the 7'-position, and to find out if the changes in colour of the isomeric 3-indole-2'-chloro-thionaphthene indigos due to the introduction of a chlorine atom in the different positions of the thionaphthene ring of the dye molecules is of the same order as already worked out by Guha and his collaborator, in the case of the four possible isomeric 3-indole-2'-methyl-thionaphthene-indigos (*J. Ind. Chem. Soc.*, 1934, 11, 395; 1937, 14, 240; 1938, 15, 501; 1944, 21, 97).

7-Chloro-3-hydroxy-thionaphthene (Dalglish and Mann, *J. C. S.* 1945, 893) was condensed with isatin and its 5-chloro-, 5-bromo-, 5:7-dibromo-, 5-bromo-7-nitro-, 5:7-dinitro-derivatives respectively and a new series of asymmetrical thio-indigoid vat dyes prepared. The dyestuffs are rusty red, dark red or violet red crystalline substances. Their shades have been uniformly developed on wool from a dilute sulphuric acid bath and on cotton from an alkaline hydrosulphite vat.

It has been noticed that these dyeing shades are lighter than those developed from the corresponding 5'-chloro-compounds (Guha and Basu-Mallick, *loc. cit.*) and their parent substances, pointing to the conclusion that the changes in colour is in the order : 5'-chloro compound > parent compound > 7'-chloro-compound.

#### 69. Studies in Indigoid Dyes. Part XI. Bis-9 : 10-phenanthrathiophene-indigo.

PARESH CHANDRA DUTTA, Muzaffarpur.

9-Thiolphenanthrene and some of its derivatives have been prepared by the author (*J. Indian Chem. Soc.*, 1941, 18, 469) with a view to preparing some interesting dyes from the point of view of colour in relation to chemical constitution. Some of these dyes have already been described in Part X (*J. Indian Chem. Soc.*, 1942, 19, 239). The present communication deals with the preparation of bis-9 : 10-phenanthrathiophene-indigo starting from 9-thiolphenanthrene through 9 : 10-phenanthroxythiophene. It is a dark chocolate dye and dyes cotton in brown shade and this result is in conformity with the findings of the author (*Ber.*, 1934, 67, 1319; 1935, 68, 1447; 1936, 69, 2343).

#### 70. Studies in Indigoid Dyes. Part XII. Phenanthrathiophene-indigos.

PARESH CHANDRA DUTTA, Muzaffarpur.

This communication deals with dyes produced by the condensation of 9 : 10-phenanthroxythiophene (described in Part XI) with phenanthraquinone, acenaphthaquinone and isatin. The condensation takes place readily in acetic acid solution in presence of traces of hydrochloric acid. The dyes derived from acenaphthaquinone and isatin produce beautiful red shades on cotton from hydrosulphite vat, whereas the phenanthraquinone compound produces dull chocolate shade as has always been found to be the case.

#### 70a. Chemical examination of *vitex peduncularis*.

SHAMBHU CHARAN MISRA, VISHWA NATH SHARMA and SALIMUZZAMAN SIDDIQUI, Delhi.

Investigations in the chemical constituents of different parts of *vitex peduncularis*, widely reputed for the treatment of black-water fever, have resulted in the isolation of vitexin,  $C_{16}H_{14}O_7$  (Perkin, *J.C.S.*, 1898, 73, 1019; Barger, *J.C.S.*, 1906, 89, 1210), along with a crystalline neutral fraction (m.p. 265°) which is being studied further. Chemical examination of the leaves is also in progress.

#### 71. Aurothio Acyl Compounds from Sulpha Drugs.

U. P. BASU and J. SIKDAR, Calcutta.

Recently certain drugs of sulpha-group are being found to exert an antitubercular activity *in vivo*. The fundamental condition for their effectiveness may be due to the fact that tubercle bacillus and the culture medium in which it is grown contain *p*-amonibenzoic acid (*cf.* Ekstrand and Sjögren, *Nature*, 1945, 156, 476) indicating thereby that this bacterium also requires the above acid as an essential metabolite. As gold compounds are often being valued in the treatment of pulmonary tuberculosis, asthma, leprosy and chronic arthritis, it was considered to be of interest to prepare certain compounds of gold with well-known sulpha drugs, and subsequently study their therapeutic effectiveness against the above diseases.

The following compounds have so far been prepared : (a)  $NH_2.SO_2.C_6H_4.NH.CO.CH_2SAu$ ; (b)  $NH_2.SO_2.C_6H_4.CH_2NH.CO.CH_2SAu$ ; (c)  $NH_2.C_6H_4.SO_2.NH.CO.CH_2SAu$ ; (d)  $C_6H_5.CO.NH.SO_2.C_6H_4.NH.CO.CH_2SAu$  and (e)  $AuS.CH_2CO.NH.C_6H_4.SO_2NH$ -thiazole. The usual procedure for their synthesis was to prepare the chloroacetyl derivative of the sulpha compound first; this was then treated with ammonium thiocyanate and the reaction product was heated with ammonia to afford the respective thiol derivative of the sulpha compound. The latter reacted with aurous bromide in alcoholic solution to afford the respective gold compound.

### 71a. Studies in the thermal degradation products of naturally occurring resinols, Part I.

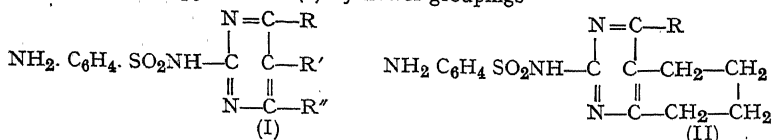
RAM PRAKASH RASTOGI, VISHWA NATH SHARMA and SALIMUZZAMAN SIDDIQUI, Delhi.

As a part of systematic study of the thermal degradation products of Bhilawan and cashew nut shell liquids and other resinols, investigation of the neutral fraction obtained through the thermal degradation of Bhilawan shell liquid, containing 60% of Bhilawanol (1:2:3— $C_6H_3(OH)_2.C_{15}H_{27}$ ), was undertaken. It has been found to consist of a mixture of  $C_{10}H_{20}$ ,  $C_{11}H_{22}$ ,  $C_{12}H_{24}$ ,  $C_{18}H_{26}$  and  $C_{14}H_{28}$  hydrocarbons, giving bromination values in each case corresponding to an aggregate of one double bond. Their oxidation with permanganate in acetone solution yields acetic, caprylic, capric, lauric, oxalic and succinic acids. The phenolic fraction of the thermal degradation products is under investigation.

### 72. On Sulphadiazine Derivatives.

U. P. BASU, Calcutta.

Although several sulphanilamide derivatives are now being found to be useful in various bacterial infections, the 2-Sulphanilamide pyrimidines being highly persistent in the blood stream, exert intrinsic antibacterial activity and become more effective therapeutic agents. The factors that determine the extent to which, and the time for which a drug may remain in the system, depend mostly on their physico-chemical properties and these might be easily changed by introducing newer substituents in the molecule. As such it was considered to be of interest to study the effect of substituting the 4, 5 and 6 positions of the 2-sulphanilamido pyrimidine (I) by newer groupings



The activities of the 4-methyl (sulphamerazine) and 4:5-dimethyl (Sulphamethazine) derivatives are known. In the present investigation 2-sulphanilamido-4:5-*cyclo*-tetramethylene pyrimidine (II, R=H)—and its 6-methyl derivatives were prepared by condensing sulphaguanidine with hydroxymethylene, and acetyl-*cyclo*hexanone respectively. Similarly *cyclo*hexanone—2-oxalate afforded 2-sulphanixamido-4:5-*cyclo*tetramethylene-pyrimidine-6-carboxylate (II, R=CO<sub>2</sub> Et.). The characteristics of these products are being studied.

### 72a. Studies in the 3-phenylcoumarin series.

PRITHVI RAJ BHANDARI, JOGENDRA LAL BOSE and SALIMUZZAMAN SIDDIQUI, Delhi.

3-phenylcoumarins form an interesting study on account of their isomerism with the corresponding flavones and isoflavones. The present authors have made a detailed study of this series in regard to the influence of various groups and their orientation, firstly, on the stability of these compounds and secondly, on the fluorescence exhibited by them in acids, alkalies and various solvents and, in some cases, in the solid state. In the course of these studies derivatives of 4'-hydroxyphenyl-7-hydroxycoumarin and 4'-hydroxyphenyl-5:7-dihydroxycoumarin have been prepared. The method employed for the syntheses consisted in the condensation of *o*-hydroxybenzaldehydes (prepared by Karrer's method through the action of bromocyan on phenols) with sodium salt of phenylacetic acids under certain conditions.

### 73. On Suppressive Antimalarials, Part II.

U. P. BASU and J. SIKDAR, Calcutta.

Sulpha-drugs have been found to exert a slight anti-malarial activity, and their antimalarial action is also being antagonised by *p*-aminobenzoic acid (Maier and Riley, *Proc. Soc. Expt. Biol. Med.*, 1942, 59, 152). But as quinine or atebirin is unaffected by *p*-aminobenzoic acid, it appears that they act through a different mechanism. Both the classes of compounds, however, exert their characteristic physiological action by inhibiting the oxygen consumption of the malarial parasites. It would, accordingly, be of

interest to undertake an investigation on the antimalarial activity of such sulpha-derivative that are not affected by the presence of *p*-aminobenzoic acid (*cf.* Goetchius and Lawrence, *J. Bact.*, 1945, 49, 575, and Marshall Jr. et. al. *J. Pharmacol. Expt. Therap.*, 1946 86, 273.)

Accordingly certain compounds namely 4- $\beta$ -diethylamino-ethylamino-6-methyl-2-sulphanilamidopyrimidine, 4- $\beta$ -diethylamidino-2-(3': 5'-dibromoanilino)-6-methyl-pyrimidine, and 4- $\beta$ -diethylaminoethylamino-2-*p*-chloranilino-6-methylpyrimidine have been prepared.

#### 73a. Chemical examination of the root bark of Nim (*Melia azadirachta*).

CHITTARANJAN MITRA, P. NARASIMHA RAO and SALIMUZZAMAN SIDDIQUI, Delhi.

In the course of studies on the bitter constituents of the Nim oil, it was noted that the crystalline bitters, nimbin (m.p. 205°) and nimbinin (m.p. 192°), reported in the earlier communications (Siddiqui, *Curr. Sci.*, 1942, 11, 278; Siddiqui and Mitra, *J. Sc. & Ind. Res.*, 1945, 4, 5) could not be obtained from certain samples of solvent extracted Nim oil of the locally collected seeds and that their yields from various commercial samples of the oil varied within a wide range. It appeared not unlikely, therefore, that these products might be the result of changes in the naturally occurring products due to storage under certain climatic conditions. As a result of investigations in the various parts of the Nim tree, it now appears likely that nimbin occurs as such in the plant body, in so far as the alcoholic extract of the air-dried root-bark of Nim has yielded this crystalline bitter along with nimbidin (m.p. 90-100°) (*loc. cit.*) in yields of ca. 0.1 and 0.4% respectively. Apart from the water-insoluble products, the bark also contains a water-soluble bitter constituent which is being further investigated. The apparent absence of nimbin in the solvent extracted oil referred to above may, therefore, be considered as due to variations in the state of maturity of the seeds at the time of their collection.

#### 74. A Commercial Synthesis of Vioform (5-chloro-7-iodo-8-hydroxyquinoline).

S. J. DAS GUPTA, Calcutta.

The chemotherapeutic properties of the drug "Vioform" as well as "Entero-Vioform" is due to the presence of the quinoline compound 5-chloro-7-iodo-8-hydroxyquinoline. This is extensively used in amoebic and bacillary dysentery. The author has found out a commercial method to manufacture this quinoline compound, the cost of production being competitive with the foreign products. Phenol is nitrated and the resulting *o*-nitrophenol is chlorinated to *p*-chloro-*o*-nitrophenol which by a modification of Skraup's reaction is converted to 5-chloro-8-hydroxy-quinoline, which is finally iodinated. *p*-Nitrophenol which is a by-product can be conveniently converted to picric acid or phenacetin.

#### 74a. Chemical examination of the Bakayan fruit (*Melia azadirach* Linn).

AMIR CHAND, CHITTARANJAN MITRA and SALIMUZZAMAN SIDDIQUI, Delhi.

The chemical examination of the Bakayan fruit (*Melia azadirach*, Linn., Persian lilac) was undertaken as a parallel to studies in the bitter constituents of Nim (Siddiqui, *Curr. Sc.*, 1942, 11, 278; Siddiqui and Mitra, *Jour. Sc. & Ind. Res.*, 1945, 4, 5) which is its sister plant, belonging to the same family, *Meliaceae*. These investigations show that in contrast to the Nim fruit, the bitter constituents of Bakayan are entirely absent in the kernel and occur exclusively in the pericarp which, in case of Nim, is free from the bitter principle. Following the mild technique employed for the isolation of the bitter constituents of the Nim oil (*loc. cit.*), an amorphous bitter principle (yield, 0.9%), provisionally named as 'Bakayanin', was obtained from the alcoholic extract of the air-dried, powdered pericarp of the fruit. Bakayanin melts indefinitely from 85° to 118° and shows  $[\alpha]_D^{20} = -42.5$  as against  $[\alpha]_D^{24} = +65$ , noted in case of nimbidin (*loc. cit.*). The order of its bitterness—1 in 10,000—is also different from that of nimbidin which is distinctly bitter in dilutions upto 1 in 1,00,000. Apart from the bitter principle, an insoluble, non-bitter, acidic fraction and a neutral, fatty fraction were also obtained, out of which the latter yielded a sterol (m.p. 137°) which in admixture with the sterol (m.p. 137°) isolated from the Nim blossoms does not show any depression in the melting point.

The fixed oil (solvent extracted) of the fruit kernel showed specific gravity, 0.9165, refractive index, 1.435, saponification equivalent, 275.3 and iodine value, 138.65. The unsaponifiable portion of the oil also yielded the sterol isolated from the pericarp. The fatty acids of the oil were found to consist of 4.9% of the solid acids comprising of stearic (0.9%), palmitic (1.9%) and myristic (1.4%), and 92.9% of the liquid acids comprising of oleic (30.0%), linolic (55.2%), lauric (1.1%) and caproic (0.4%) acids.

75. Derivatives of *p*-Aminobenzene Phosphonic Acid (phosphanilic acid).

N. S. LIMAYE and B. V. Bhide, Poona.

Very little attention has been paid to the study of chemotherapeutic properties of organic phosphorous compounds. Recently some organic phosphorous compounds have been shown to have activity against streptococcal infections in mice equal to that of sulphanimide (cf. H. Bauer, *J. A. C. S.*, 63, 2137, 1942). It was, therefore, intended to prepare derivatives of 4-aminobenzene phosphonic acid (phosphanilic acid) with a view to test their chemotherapeutic properties. The following derivatives are described in this paper:

(1) Benzoyl phosphanilic acid, (2) Ureido-phosphanilic acid, (3) Chloracetyl phosphanilic acid, (4) Benzylidene phosphanilic acid, (5) Resorcinol-azo-phosphanilic acid, (6) *m*-Phenylene diamine-azo-phosphanilic acid, (7) the corresponding pyrrole derivative. The corresponding amido-derivatives are in the course of preparation.

75a. Chemical examination of the Nim blossoms (*Melia azadirachta flora*).

CHITTARANJAN MITRA, P. NARASIMHA RAO, SATYENDRA BHATTACHARJI and SALIMUZZAMAN SIDDIQUI, Delhi.

As an extension of the work so far carried out on the Nim seeds (Siddiqui, *Curr. Sci.* 1942, 11, 278; Siddiqui and Mitra, *J. Sci. & Ind. Res.*, 1945, 4, 5) to the other parts of the tree, the Nim blossoms which are reputed as a tonic after fevers and are also used in the treatment of atonic dyspepsia, were taken up for investigation. The following products were isolated from the cold alcoholic percolate of the powdered, air-dried blossoms:

(The names have been provisionally assigned to the various new substances in accordance with the nomenclature employed in case of the bitter constituents of the Nim oil.)

1. Nimbo-sterol,  $C_{20}H_{34}O$ , m.p. 137°, colourless needles and leaflets (yield, 0.03%).
2. Nimbo-sterol-glucoside, m.p. 294°, clusters of needles (yield, 0.01%).
3. Nimbicetin,  $C_{15}H_{26}O_2(OH)_4$ , m.p. 272°, fine yellow needles (yield, 0.05%).
4. Nimbolin, a sesquiterpene derivative,  $C_{15}H_{24}O_2$  (yield, 0.5%).
5. A saturated hydrocarbon, nonakosane,  $C_{29}H_{60}$ , m.p. 64-66°, flakes (yield, 0.01%).
6. Fatty acids: behenic, arachidic, stearic, palmitic, oleic and linolic.

It may be noted here that no bitter constituent could be isolated from the blossoms and that the water-soluble portion of the alcoholic extractive yielded a crystallizate of inorganic salts consisting mainly of potassium chloride, while a qualitative analysis of the ash (6.3%) of the blossoms indicated the presence of sodium, potassium, calcium, iron, chlorides, carbonates, sulphates, phosphates and silica.

76. Chemical Examination of Hingora Seeds (*Balanites Roxburgii*, N.O. Simarubæ).

V. V. DHEKANE and B. V. BHIDE, Poona.

Hingora seeds have been subjected to a thorough chemical analysis. The pericarp of the seeds contain 10% saponin which is likely to be a very good wetting out reagent. A method has been worked out for its extraction. It has not been found possible to get the saponin in a crystalline form. However by hydrolysis with hydrochloric acid, a crystalline substance (m.p. 189-190°) has been isolated. It has a mol. wt. of 325, does not contain nitrogen or sulphur and gave an acetyl derivative m.p. 172°. The filtrate from hydrolysis gave tests for Ahamnore (tested by osazone formation).

The kernel of the seeds yields about 40% of a fatty oil which has also been analysed. The composition of the component acids of the fatty oil is: palmitic (22.9%), stearic (15.6%), arachidic (1.3%), oleic (34.5%) and linolic acid (25.5%).

## 76a. Studies in the subsidiary constituents of pyrethrum flowers.

A. VENKATAKRISHNAN SUBBARATNAM, P. PARAMESWARAN PILLAY and SALIMUZZAMAN SIDDIQUI, Delhi.

In course of continued work with pyrethrum flowers in connection with the preparation of biologically stable, higher concentrates of pyrethrins, with the aid of solvents easily available in India (Indian Provisional Patent Specification No. 35338 dated 8th August 1946), one of us exhibited symptoms of a peculiar form of dermatitis with smarting of the skin and swelling of the eyes. Susceptibility of this nature in some individuals has been noted by earlier authors, but in so far as the pyrethrins are found

to be definitely nonirritant even in concentrations as high as 93%, it has been generally agreed that the irritant principle must be a separate and distinct constituent of pyrethrum flowers (Feinberg, *J. A. Med. Assoc.*, 1934, 102, 1557; Gnadinger, *Pyrethrum Flowers* Second Edition).

Studies in the pyrethrum flowers, directed towards the isolation of the irritant principle, have led to the separation of certain water-insoluble phenolic fractions, which have not so far found any reference in the extensive literature on pyrethrum and may prove to be the irritant factor. Efforts are now being made to follow the irritant principle by comparative pharmacological study of the various fractions.

Further certain carotenoid pigments from the petrol-ether soluble fractions have been isolated. These pigments are also the subject of further investigation.

#### 77. Chemical Investigation of the Seeds of *Ipomoea muricata*. (N.O. Convolvulaceæ).

G. M. KELKAR, N. L. PHALNIKAR and B. V. BHIDE, Poona.

Our recent observation regarding the occurrence of behenic acid to the extent of 6.6% in the seed-fat from *Argyria speciosa* (N. O. Convolvulaceæ) (*Proc. Ind. Sci. Congress 33rd Session, Part III*, page 67, 1946) has led us to the study of other seed-fats from plants belonging to the natural order Convolvulaceæ. The present paper deals with the chemical investigation of the seeds of *Ipomoea muricata*.

The seeds of *Muricata* on extraction with ether gave a fatty oil (8.7%). The component acids of the fatty oil have been found to be palmitic (13.6%), stearic (22.5%), behenic acid (3.8%), linolenic (3.9%), linolic (15.2%) and oleic acid (40.9%).

The seeds were also found to contain an alkaloid (m.p. 200°) which gives a picrate (m.p. 103°). Further investigation of this alkaloid is in progress.

#### 77a. Growth promoting factors from germs of Indian pulses.

ASPARI KRISHNAMURTHY, JOGENDRA LAL BOSE and SALIMUZZAMAN SIDDQUI, Delhi.

Biochanin-C, one of the crystalline products isolated from the germs of Bengal gram (Siddiqui, *J. Sci. Ind. Res.*, 1945, 3, 68), has been found to accelerate and increase the growth of lower plant organisms in very high dilutions.

Several strains of yeast (*Saccharomyces cerevisiae* and *Torula utilis*) were grown in culture media containing Biochanin-C in varying concentrations (0.25 mg./cc to 2 mg./cc) and more than 100% increase in the growth of yeast cells were recorded. The yeast growth was measured turbidimetrically with the help of photoelectric colorimeter after 18 hours of incubation.

The effect of Biochanin-C on one strain of *Penicillium notatum* (Fleming) was also studied employing similar concentrations. A 25% increase in the mycelial growth was observed after washing the mycelium thoroughly with water and drying it to constant weight at 110°. It thus appears that at an optimum concentration of 0.75 mg./cc, Biochanin-C has a marked effect on the vegetative growth of lower plant organisms.

#### 78. Chemical Study of the Seed Kernels of *Prunus armeniaca*, Linn. (Bitter Apricots).

D. R. DHINGRA and U. N. SHULKA, Cawnpore.

The components of the bitter apricots, *Prunus armeniaca*. (Chilu) fat consist of 2.69% myristic, 4.40% palmitic, 1.12% stearic, 0.30% arachidic, 68.42% oleic, 21.69% linoleic acids and 1.38% unsaponifiable matter. Its essential oil yields benzaldehyde on steam distillation.

The oil possesses pleasant odour and taste and is of a very light pale colour. It is not at all bitter and hence can be used for medicinal and edible purposes as a substitute for more expensive almond oil. Moreover, the oil is of a non-drying type and as it contains a very small percentage of lower saturated acids and does not deposit any solid glycerides even at extreme winter temperature, it can be used as a very good lubricating oil for watches and other fine machinery, after admixing it with light mineral lubricating oil. Further experiments in this connection are in progress.

Chilu seed kernels, being bitter in taste, are wasted in the hills and if arrangements are made for their collection, it would be paying to express oil. Minimum profit of Rs. 7/- per maund of oil produced can be made and several thousands maunds of seeds can be easily collected for the purpose. Moreover, it is likely to solve a part of the food problem as oil shortage in the country is very great.

## 78a. Synthetic tanning materials from Bhilawan and Cashew shell liquids.

MOHAMMAD ABDUL GHANI, NANUBHAI BAPUBHAI DESAI and SALIMUZZAMAN SIDDIQUI, Delhi.

In view of the presence of a benzenoid nucleus containing hydroxyl or carboxylic groups in the Bhilawan and Cashew shell liquids, the possibility of utilizing the shell liquids or their thermal degradation products as starting materials for the preparation of syntans was investigated.

The sulphonated products on condensation with formaldehyde were employed alone as well as in conjunction with vegetable tanning materials for the tanning of hides. The results show that while Bhilawan and Cashew nut shell liquids yield suitable products only when their sulphonation and condensation are carried out with the incorporation of their thermal degradation products or of lower phenols like cresylic acid in certain proportions, the thermal degradation products of the shell liquids can be utilised as such.

When a mixture of the thermal degradation products of Bhilawan shell liquid and cresylic acid (2:3) was sulphonated and condensed with formaldehyde a water soluble condensation product was obtained which, when employed in conjunction with Babul extracts, yielded better results in respect of fullness, uniformity of tannage and suppleness than were obtainable with Babul alone or in combination with the commercial syntan 'Nerodal'. Similar results were obtained with wattle using the various syntans as adjuncts in the tannage. Like others, the Bhilawan syntans also reduce the tanning time, and have the further advantage of giving a simultaneous fat-liquoring effect to the leather.

From the results so far obtained the cashew syntans appear to give harsher leather than that obtained with the corresponding Bhilawan products.

79. Chemical Examination of the Seeds of *Citrullus colocynthis*, Schrader. Part III.

R. C. BADAMI and R. L. ALIMCHANDANI, Dharwar.

The fatty oil from the seeds has been completely analysed and the different constituents separated. The solid acids contain a trace of myristic acid and large amounts of palmitic and stearic acids. The liquid acids contain oleic and linoleic acids.

The work on the bitter principle isolated from the alcoholic extract of the seeds is in progress.

79a. Studies in the alkaloidal constituents of *Stephania glabra*, Part I. Isolation of two crystalline alkaloidal salts and a crystalline base.

SALIMUZZAMAN SIDDIQUI, Delhi.

In view of the reputation of some of the *Stephania* species in the treatment of pulmonary tuberculosis and asthma, investigations on the constituents of *Stephania glabra* (Gindaru), which has also found use as an antiperiodic, were undertaken. From the alcoholic extracts of the air-dried tuber two crystalline alkaloidal salts (m.p. 222° and 248°) and a crystalline diacidic base provisionally named as gindarine (m.p. 147°; hydrochloride, m.p. 227°; nitrate, m.p. 222°; hydroiodide, m.p. 229°; picrate, m.p. 180°; chloro-platinate, m.p. 229°) have been isolated in a total yield of ca. 3% on the weight of the dried material. On the basis of micro-analytical data gindarine has been provisionally assigned the formula  $C_{42}H_{52}O_8N_2$  and 7 out of the 8, oxygen atoms in the molecule have been shown to be present in methoxyl groupings.

One of the salts (m.p. 222°) has been found to be gindarine nitrate. It has further been noted that the higher melting, orange yellow alkaloidal salt does not occur in the fresh tuber and is probably an oxidation product of gindarine formed during the process of drying, the conversion being nearly complete when the tuber is cut up into small pieces and allowed to dry slowly during the hot and humid monsoon weather.

79b. Studies in the alkaloidal constituents of *Stephania glabra*, Part II.

GOVIND RAI CHAUDHURY and SALIMUZZAMAN SIDDIQUI, Delhi.

From the mother liquors of gindarine, another crystalline base provisionally named as gindarine (m.p. 187°,  $[\alpha]_D^{20} = -137^\circ$ ; hydrochloride, m.p. 258°; hydroiodide, m.p. 231°; picrate, m.p. 139-40°; chloro-platinate, m.p. 230°) has been isolated. On the basis of micro-analytical data it has been provisionally assigned the formula,  $C_{40}H_{42}O_7N_2$ .



The orange yellow alkaloidal salt (m.p. 248°) reported by Siddiqui has been established as the nitrate of a diacidic base, which has been provisionally named as gindarinine (m.p. 141°; hydrochloride, m.p. 217°; hydroiodide, m.p. 245°). The free base, which is white but readily colours on exposure to air, gives stable orange-yellow salts. The melting points of the salts prepared from the liberated base are identical with the corresponding salts obtained through double decomposition of the naturally occurring gindarinine nitrate which has been provisionally assigned the formula,  $C_{46}H_{50}O_{16}N_2 \cdot 2HNO_3$ . Gindarine, gindarinine and gindarinine nitrate show the absence of active hydrogens, side-chain methyls and N-methyl groups. Studies on the constitution of these bases are in progress.

Preliminary experiments kindly carried out by Mrs. Osborn at the Sir William Dunn School of Pathology, Oxford, show that gindarinine nitrate possesses definite antibiotic action against *Staphylococcus*, while gindarine nitrate is inactive.

#### 80. Investigations on the Indian Soapnut Saponin.

H. G. Biswas, Calcutta.

An improved method for the preparation of pure saponin from Indian Soapnut has been described. The pure substance melts at 145° and gives the characteristic tests for saponin. A sapogenin melting at 328-329° is produced on hydrolysis. The acetyl derivative of the sapogenin melts at 170°. The melting points and analytical data of these compounds correspond to those of the analogous compounds prepared by Jacobs *et al* and Winterstein *et al* from Soapnuts of foreign origin.

#### 81. "Karaya Gum" and Tragacanth—a comparative study.

I. B. BOSE and J. MUKHERJEE, Calcutta.

During the war, tragacanth (*Astragalus gummifer* Labil) which is usually imported from Iran, Iraq and the neighbouring countries, became in short supply and this led to the study of "Karaya Gum" (*Stereoculia urens* Roxb.) which is plentifully available in India, as a replacement of the "official" gum in pharmaceutical preparations.

The Indian gum is usually available in irregular, striated, whitish or pinkish-brown masses, weighing up to 20 gm. The following characteristics have been recorded from the examination of a large and representative collection, made through authentic sources under the auspices of the Officer-in-charge, Industrial Section of the Botanical Survey of India :—

(1) Swelling property	...	...	0.5 gm. gum swells up to 75 c.c. on absorption of 75 c.c. water.
(2) Solubility in water	...	...	Very little (about 0.2%).
(3) Ash	...	...	6 to 7%, containing Ca, K and Carbonates.
(4) Volatile acidity (after hydrolysis with 5% phosphoric acid)	...	...	4 to 6.5% calculated as acetic acid.
(5) Acidity (c.c. of N/10 NaOH for 1 gm. gum)	...	...	6.36
(6) Staining characteristics	...	...	Bright pink with ruthenium red and green with $ZnI_2$ and KI.
(7) Mucilaginous property	...	...	Very good, forms homogeneous, adhesive and gelatinous mass with water.
(8) Viscosity	...	...	Very high according to B. P. C. method of testing.
A 1.15% mucilage has more or less identical viscosity with a 1.25% mucilage of tragacanth.			

A comparison of these properties with B. P. Tragacanth indicates close similarity in many aspects, the Indian gum appearing to be superior, particularly with regard to viscosity. The wide use of this gum, as a suspending agent in mixtures containing resinous tinctures and heavy insoluble powders, in emulsifying volatile oils and as a constituent of glycerine toilet creams and jellies, and as a binding agent in pills, tablets, etc., has given uniformly good results. Its employment as a substitute of the "official" gum is therefore, recommended with the proviso that only gums of "good grade" (as indicated by colour, size and other physical characters) be used in pharmaceutical practice.

## 81a. Chemical examination of "Archa": Isolation of two colouring matters.

GOVIND RAI CHAUDHURY and SALIMUZZAMAN SIDDIQUI, Delhi.

Two crystalline colouring matters have been isolated in a total yield of nearly 3% of the crude drug. One of them which is brilliant orange-red in colour and melts at 245° has been provisionally named as Archin while the other which is lemon-yellow in colour and melts at 185° has been named as Archinine. Both these colouring matters are extremely resistant to alkalis and are soluble in fats and oils imparting to them a golden yellow colour in large dilutions. Studies on their constitution are in progress. The possibility of their utilisation for colouring vegetable ghee is also being investigated.

From the aqueous extract of the final mother-liquors a small quantity of a water-soluble crystalline product (m.p. 245-50°) has also been isolated.

## 82. A Test of Glucose.

BINAYENDRA NATH SEN, Burdwan.

A copper salt is treated gradually with ammonium hydroxide till a deep blue solution is obtained. Alkali hydroxide is now added drop by drop till the colour of the solution fades to clear light blue shade. Glucose is then added. Reduction takes place on just warming (38°-40°) the mixture, red cuprous oxide being precipitated. Reduction also takes place without warming the mixture but after an induction period. The clear solution in this case throws out the yellow precipitate of cuprous hydroxide which subsequently changes to the red cuprous oxide.

## 82a. Studies in the Chemistry and applications of Indian Oleo resins. Part I

ANIL KUMAR BOSE, AJIT KUMAR DAS-GUPTA, KAMALA KINKAR CHAKRAVARTI and SALIMUZZAMAN SIDDIQUI, Delhi.

Several methods are available for the transformation of the primary acids present in rosin into *l*-abietic acid (Steele, *J.A.C.S.*, 1922, 44, 1333: boiling rosin with 98% acetic acid for two hours; Ruzicka and Meyer, *Helv. Chim. Acta.*, 1922, 5, 315: distillation at 200-10° below 1 mm. bath temperature, 255°; Dupont, Deselbres and Bernette, *Bull. Inst. Du Pin*, 1926, 22, 349: refluxing with alcoholic hydrochloric acid and isolation through the acid-sodium salt; Kesler, Lowy and Faragher, *J.A.C.S.*, 1927, 45, 2899: passing a current of hydrochloric acid gas through molten rosin and isolation through the acid sodium salt). There has been a great deal of confusion, however, regarding the uniformity of the acid obtained by the various methods, inasmuch as that the extent and character of the transformation, which is now generally recognised to involve only a process of isomerisation, varies within a wide range according to the solvents, reactants and experimental conditions employed. It has been particularly noted in this connection that under more drastic conditions, as for instance distillation of rosin in vacuo, a product melting about 10° higher is obtained which is dextro-rotatory, and is referred to as pyro-abietic acid. On account of the fact that abietic and pyro-abietic acids have similar solubilities and their melting points are very close to each other, the separation of these two products presents exceptional difficulties and many of the products noted in literature cannot for this reason be considered as pure products.

Out of the considerations noted above, Steele's method which records a yield of 40% of *l*-abietic acid in a fairly pure state, is generally accepted as convenient and reliable. Following this method Rau and Simonsen (*Ind. Forest Records*, 1924, 11, Part 6) isolated from rosin derived from *Pinus longifolia*, *l*-abietic acid, m.p. 168-69° (yield not mentioned) which they found to be identical with the acid present in *P. palustris*, although it has been noted by them that the rotatory power in alcohol is higher,  $[\alpha]_D^{20} = -95^\circ$ .

Attempts have been made to work out a simple and economic method for the preparation of *l*-abietic acid, under mildest possible conditions. This method, based on the addition of a 1:1 mixture of alcohol and hydrochloric acid to an alcoholic solution of rosin at 20-25° (3% hydrochloric acid by weight on the quantity of rosin and the solvent), directly secures within 20 to 30 minutes a yield of 75% of fairly white crystallisate (m.p. 148-52°;  $[\alpha]_D^{25} = -55^\circ$ ), which on crystallisation from alcohol at ordinary temperature gives pure *l*-abietic acid (plates; m.p. 157-59°;  $[\alpha]_D^{25} = -69^\circ$  in 1% alcoholic solution; Steele's acid, m.p. 161-65°;  $[\alpha]_D^{20} = -80^\circ$ ; Ruzicka and Meyer's acid, m.p. 158°;  $[\alpha]_D^{20} = -68.5^\circ$ ; Dupont and *et al*'s acid, m.p. 168°).

In the course of these investigations further evidence has been brought against the theory of the occurrence of the primary rosin acids as anhydrides (Maly, *Ann.*, 1864, 132, 249;

Bischoff and Nostrogel, *Chem Review*, 1849, 106 ; Knecht and co-workers, *J. Soc. Dyers. Colorists*, 1919, 35, 148 and 1923, 39, 338 ; Steele, *loc. cit.*) by following the course of titration in alcoholic medium in parallel experiments with rosin and abietic acid, and also by noting the changes in optical activity of oleo-rosin and freshly prepared rosin through the influence of solvents, with and without the addition of acids.

82b. Chemical examination of *Psoralea Corylifolia*, Linn (Babchi).

KAMALA KINKAR CHAKRAVARTI, ANIL KUMAR BOSE and SALIMUZZAMAN  
SIDDQUI, Delhi.

A new crystalline lactone provisionally named as psoralidin,  $C_{16}H_{14}O_4$ , (m.p.  $315^\circ$ , dec.) has been isolated from the pericarp of the Babchi seeds, apart from psoralen and isopsoralen, which were isolated by Jois, Manjunath and Venkatarao (J.I.C.S., 1933, 41) from the crushed whole seeds and were later found by Sheshadri and Venkatarao (*Proc. Ind. Acad. Sci.*, 1937, 5A, 351) to be present in the kernel but not in the pericarp. Psoralidine could not be isolated from the kernel which only gave psoralen and isopsoralen and the fixed oil.

On the basis of analytical values of its methyl derivative (m.p.  $190^\circ$ ) and acetyl derivative (m.p.  $220^\circ$ ), indicating the presence of one hydroxyl group, and its probable genetic relationship with psoralen, it appears likely that psoralidin is a furo-coumarin with a hydroxyl and an isoprene unit attached to it, as in case of allo-imperatorin (Spæth and Holzen, Ber., 1933, 1137).

Further work on the constitution of psoralidin is in progress.

82c. Chemical investigation on *Gum euphorbium* (Vern. Farfiun), the dried latex of *Euphorbia resinifera*.

KARIMULLAH and PRAKASH NARAIN, Delhi.

Bauer *et al* (*Arch. Pharm.*, 1928, 266, 633 ; *ibid* ; 1931, 269, 209) isolated two alcohols from euphorbon, the neutral substance obtained by Flückiger (Vierteljahresschrift für prakt. pharm. XVII (1868), 82-102), from the latex of *E. resinifera* and considered by him to be a homogenous substance. Müller (*J. pr. Chem.* 1929, 121, 97) also isolated two alcohols from euphorbon to which the names Vitorbol, m.p.  $120-125^\circ$  and Novorbol, m.p.  $123.5-124.5^\circ$  were assigned. Bauer and Schröder, however, think that Vitorbol is impure  $\alpha$ -euphorbol and Novorbol is not homogenous.

More recently Newbold and Spring (*J. Chem. Soc.* 1944 p. 249-251) isolated two crystalline monohydric alcohols by chromatographic analysis. One was stated to be identical with  $\alpha$ -euphorbol of Bauer and Schröder and the other having the empirical formula  $C_{30}H_{50}O$  was named Euphol, m.p.  $116^\circ$ .

Work in this laboratory on the chemistry of the latices from *Euphorbiaceae* in general, and *E. tirucalli*, *E. ianticatorum* in particular, was extended to the investigation of the above problem.

When chromatographed through a column of activated Fuller's earth the neutral portion from gum euphorbium yielded two crystalline substances, one from the column, m.p.  $125-126^\circ$  and the other from the filtrate, m.p.  $117-118^\circ$ . Their acetyl products melted at  $120-121^\circ$  and  $110-111^\circ$  respectively.

On the basis of mixed melting point determination these compounds were found to be different from those isolated by the British authors, who kindly supplied us with samples of Euphol and euphol-acetate and  $\alpha$ -euphorbol-acetate. Further work on the constitution of these compounds is in progress.

82d. Chemical examination of some new Drying Oils, Part I. Fatty oil from the seeds of *Mallotus philippensis* Muell. ARG.

JOTI SARUP AGGARWAL and KARIMULLAH, Delhi.

The kernels from the seeds of *Mallotus philippensis* Muell. ARG. commonly known as kamla (N. O. *Euphorbiaceae*) on extraction with petrol ether, gave 24% of a clear

yellowish brown oil of drying nature. Some important characteristics of this oil are as follows:—

Sp. gravity at 40°C	...	...	0.9409
Viscosity at 40°C	...	...	386.3 cestistokes
Refractive index at 30°C	...	...	1.5052
Saponification value	...	...	192.8
Unsaponifiable matter	...	...	1.7%
Soluble fatty acids	...	...	1.4%
Hehner value	...	...	93.8
Saturated acids by Bertram's method	...	...	12.3%
Titer test	...	...	45.5°C
Acetyl value	...	...	15.6
Hexabromide value	...	...	0.3
Carbonyl value	...	...	Nil
Iodine value (Wijs)	...	...	161.7
Iodine value (Woburn iodine method A)	...	...	175.6
Iodine value (Woburn iodine method B)	...	...	179.0
Partial iodine value (Wijs 2 minutes)	...	...	122.6
Diene value (from difference in iodine values)	...	...	56.4
Brown's Heat Test	...	...	9 minutes & 30 seconds
Neutralisation value of the total fatty acids	...	...	199.4
Iodine value fatty acids (Woburn method B)	...	...	182.7

The separation of the total fatty acids into components by usual lead salt-alcohol process was not possible as the acids have a great tendency to polymerise. The saturated acids obtained by Bertam's oxidation method had neutralization value 227.3 from which a composition of 64.8% palmitic acid and 35.2% myristic acid was calculated. A yellowish solid product remained undissolved when the total acids were ground with light petrol ether. This product on crystallisation from benzene yielded yellowish white needles m.p. 86°-87°. It formed about 45% of the total acids. It had the following characteristics:—

Neutralization value	...	...	201.6
Iodine value (Woburn iodine method B)	...	...	237.5
Diene value (maleic anhydride Ellis & Jones method)	...	...	137.9

This acid was found to be very unstable. Partial polymerisation was noticed after 24 hours, the polymerised product being no more soluble in benzene or chloroform. Hydrogenation of this acid in the presence of platinum catalyst gave a stable white crystalline compound, m.p. 101° (C=71.57%, H=12.71%). Further work to elucidate the structure of this acid is in progress.

A film of the oil in turpentine containing some lead linolenate was applied on a glass plate. It dried after five hours, but the film was not very tenacious and had a wrinkled appearance. The various uses of this oil are being investigated.

82e. Crystalline components of the seeds of *Heracleum nepalense* (N. O. Umbellifereae).

D. CHAKRAVARTI and C. N. BHAR, Calcutta.

The following compounds have been isolated from the seeds of *Heracleum nepalense*: (i) Bergapten, m.p. 188-89° (0.02-0.03% yield); (ii) an isomer of bergapten, m.p. 157-158° (0.15% yield); (iii) Byakangelicin, m.p. 124-126° (1% yield); (iv) alloimperatorin, m.p. 228-229° (0.04% yield); (v) a crystalline compound, m.p. 202-204° (2% yield), which is under investigation, and (vi) a crystalline compound, m.p. 231° (in traces).

### Biochemistry

83. Study on the Ascorbic Acid Contents of Common Fruits and Vegetables of Gujarat. Part I. Vitamin C Contents of Common Fruits and Vegetables.

K. G. NAIK, C. C. SHAH and H. G. PANDYA, Baroda.

Twenty-seven fruits and thirty-six vegetables were examined for their ascorbic acid contents. Some of the common vegetables and fruits of Gujarat are found to contain

unexpectedly high ascorbic acid content. Amongst fruits, Amla, Jamrukh, Goras Amla, Narangi, Papaya are rich sources of vitamin C. Amongst vegetables, Kankoda, Karela, Saragava, Dhana and other bhajis contain sufficiently large amount of ascorbic acid. The Amla fruit retains large proportion of vitamin C even on drying.

#### 84. Study of the Ascorbic Acid Content of Common Fruits and Vegetables of Gujarat. Part II. Effect of Cooking and Frying on Vegetables rich in Vitamin C.

K. G. NAIK, C. C. SHAH and H. G. PANDYA, Baroda.

This part deals with the effect of cooking and frying, with and without salt, on the stability of vitamin C. It is seen that ordinary cooking does not destroy all the ascorbic acid. The vegetables retain varying proportion (30 to 70%) of it. In no case, increase in vitamin C contents on cooking due to "bound forms of ascorbic acid" was observed. The common salt appears to exert a marked stabilizing effect on vitamin C, as substances cooked with salt, show higher retention values for vitamin C, than when cooked without salt. Contrary to the popular belief, frying in ghee or oil destroys less of vitamin C. The effect of preservation on the retention of vitamin C has also been examined. The pickles and jams of all fruits retained negligible quantity of vitamin C on storage, with the single exception of Amla fruit, which retained 20% of its vitamin C, even after the storage of twelve weeks.

#### 85. Study on the Ascorbic Acid Content of Common Fruits and Vegetables of Gujarat. Part IV. Correlation between Vitamin C Content, pH Value, and Carbohydrate Contents of Fruits and Vegetables.

K. G. NAIK, C. C. SHAH and H. G. PANDYA, Baroda.

The possible correlationship between vitamin C content, pH values and carbohydrate contents of six fruits and two vegetables at different stages of growth is sought. It was seen that as the fruits and vegetables developed, there was a progressive increase in vitamin C content (except Guava and Grapes); there seemed to be a corresponding increase in reducing and non-reducing sugars. For all fruits (except Chiku), it is apparent that (i) their starch contents go on decreasing with development of fruits due to its gradual conversion into fructose and sucrose, (ii) that in case of all fruits (except Chiku and Chillies) their pH tend to fall as fruits develop.

#### 86. Iron Content of Vegetables of Gujarat.

C. C. SHAH and S. Z. PATEL, Baroda.

The wide prevalence of anemia, both of hypochromic and pernicious type, among the younger generation and particularly in women in Gujarat is significant. Proper nutrition by vegetables containing iron should at least lead to the disappearance of the hypochromic anemia. To enable public health workers and clinicians to give proper advice, it is essential to know the total iron and available iron in the commoner foods. Green foods are generally the chief sources of the nutrient. The present paper is a study in the iron content and its variation in some thirty-three vegetables commonly used in Gujarat.

It has been found that mint, curry leaves, spinach, luni, fenugreek and Tandalja (*Amranthus Gangeticus*) are rich sources of iron. A 4 oz. portion would be sufficient for a day's supply. Pumpkin has the lowest iron content.

#### 87. Chemotherapeutic Studies on Organo-antimony Compounds.

S. J. DAS GUPTA, Calcutta.

It is well known that organic compounds of pentavalent antimony exert a specific action in *Kala-Azar*. Nearly all antimonial compounds introduced into medicine are salts or derivatives of stibanilic acid (*p*-aminophenylstibonic acid). Of all these preparations the most widely used is the antimonial, Urea-Stibamine introduced by Brahmachari in 1922 (*Ind. J. Med. Res.* 492, 10, 1922). Though Urea-Stibamine is a very potent drug against *Kala-Azar* it suffers from one drawback. It cannot be administered intramuscularly or subcutaneously. While engaged in finding out an antimonial suitable for intramuscular use, the author has synthesised diethylamine salt of S-diphenyl Carbamido-4: 4-distibonic acid. This compound is very stable and highly soluble in water and pharmacological experiments have shown that it is of low toxicity and suitable for intramuscular use.

# 88. *In Vitro* Observations on the Anthelmintic Action of some Synthetic Lactones.

R. N. IRANI, N. L. PHALNIKAR and K. S. NARGUND, Poona.

The following series of lactones have been tested for their anthelmintic action by studying their toxicity to earth-worms. The method used was the immersion method of Sollomann (*J. Pharm and Exp. Therap.* 22b, 129, 1919):

- (1)  $\gamma$ -3-alkyl-4-methoxy-phenyl-butyrolactones.
- (2)  $\gamma$ -5-alkyl-2-methoxy-phenyl-butyrolactones.
- (3)  $\gamma$ -2 : 4-dialkoxy-phenyl-butyrolactones.
- (4)  $\gamma$ -5-alkyl-2 : 4-dimethoxy-phenyl-butyrolactones.

The toxicity of the lactones has been discussed in relation to their chemical constitution.

# 89. A Study of Frog Depot Fat.

G. M. KELKAR, N. L. PHALNIKAR and B. V. BHIDE, Poona.

The frog (*Rana Tigrina*) depot fat has been analysed. In addition to stearic, palmitic and myristic acids, hexoic, octoic and decaic acids have been found to be present. Presence of oleic acid and moroctic acid (octadecatetraenoic acid) in the unsaturated acid portion of the fat has been proved. The presence of moroctic acid and  $C_8$  to  $C_{10}$  lower saturated acids is remarkable. The results are compared with those obtained by Klenk (*Z. Physiol. Chem.* 222, 264, 1933).

# 90. Effect of Dilution on the Ionic Environment of Diphtheria Antibodies in different pH Ranges.

M. M. BISWAS, Calcutta.

Conductometric titrations of concentrated diphtheria antitoxic serum have been carried out with  $N/10$ -hydrochloric acid for a number of dilutions of the antibody. Corresponding pH values have been recorded. The titration curves suggest that the concentrated antibodies exhibit a greater affinity for  $H^+$  and  $Cl^-$  ions and that dilution influences this affinity in a remarkable way, diminishing the capacity for ionic adsorption. Particularly the adsorption of  $H^+$  ions by concentrated antibodies seems to be very prominent in the titration curves.

# 91. The Solubilisation of Quinine by Bile Salts.

S. MUKHERJEE, Calcutta.

The mechanism of the solubilisation of quinine base by bile salts has been discussed. From turbidimetric titrations of bile salts with quinine and turbidity-concentration curves of colloidal solutions of quinine-dehydrocholic acid and tauroglycocholic acid complexes, it has been concluded that solubilisation takes place through the formation of micelles composed of quinine and bile salts. Two types of micelles are envisaged, primary micelles built up by the association of quinine with bile salt molecules or with very small micelles; and secondary micelles formed of quinine molecules and large micelles of bile salts. Primary micelles are easily diffusible while secondary micelles form irreversible precipitates. Solubilisation is accompanied with the formation of primary micelles. This would explain the difference in solubilising powers of sodium dehydrocholate and tauroglycocholate.

## Industrial Chemistry

# 92. Manufacture of Emetine Hydrochloride from Indian Ipecacuanha.

S. K. SAHA, Calcutta.

A direct and economic process has been developed by which emetine hydrochloride can be prepared from Ipecacuanha roots. Powdered roots are mixed with straw, lime and water and extracted with mixture of benzene and petroleum-ether in specially designed apparatus in which the solvent circulates in continuous cycle first through the drug, then through dilute hydrobromic acid and finally through a reservoir into drug again until extraction is complete. Emetine directly separates out as emetine hydrobromide and is filtered off and converted into the hydrochloride in usual manner. Yield is 95% of theory.

## 93. Cryoscopic Studies in some Indian Edible Oils and Fats.

S. S. PHATAK, K. K. DOLE and D. D. KARVE, Poona.

Lowering of freezing point of benzene in presence of different quantities of edible oils and fats has been studied. The cryoscopic method can be applied to get very accurate molecular weights of oils and fats. These molecular weights, although of empirical character, would be of immense utility for getting a fresh knowledge about oils and fats. It is observed that the values obtained with different oils and fats are fairly constant with the same variety of the oil or fat. A detailed study of butter fat (ghee) indicates that the values of m.w. vary within a very narrow range. It may therefore be confidently suggested that the cryoscopic determination of molecular weights would be of great use towards the detection of adulteration of ghee. The molecular weights of common adulterants have also been studied and the results support the above conclusion. A correction has been applied for the presence of free acids which lower the values of m.w.

## 94. Detection of Adulteration in Ghee.

C. C. SHAH and H. M. PATEL, Baroda.

The different constants—R. M., P. V., I. V., S. V. and B. R. at 40°C of a large number of samples of pure ghee prepared under supervision and of artificial mixtures with tallow, cocogem and Dalda have been determined. The results of examination of some two thousand market samples of ghee were also available for study. A detailed examination of the results obtained shows that for Gujarat, all samples of pure ghee show a definite relation between the S. V. and B. R. at 40°C. A sample of pure ghee falls within a limited field on graph showing the relation between S. V. and B. R.

## 95. Bating Agents for Hides.

U. P. BASU and S. SEN, Calcutta.

For preparing a leather from a raw hide the epidermis and subcutaneous tissue of the latter is to be removed by the process of unhairing and "bating" of the skins. Usually the process of bating is carried out by means of a proteolytic enzyme in conjunction with a deliming agent such as ammonium chloride. But the bating agent that was usually used in India, was imported from abroad. In order to meet the local demand during world War II when the supplies almost ceased, a process was devised for the preparation of such an agent from pancreatic glands collected from the local slaughter house and Wheat bran inoculated with spores of a mould of the species *Aspergillus oryzae*. The method of the preparation and adjustment has been described. It is being reported that chrome leather made from the unhaird hides with the above bating agent is soft and has a smooth and slippery feel.

## 96. Preparation of Tannic Acid B.P. from Myrobalan.

H. G. BISWAS, Calcutta.

By employing a mixed solvent (ether and alcohol in the proportion of 3:1) in the extraction of myrobalan powder and by adopting certain methods of purification tannic acid B. P. has been prepared. With suitable extraction stills and vacuum drying arrangements the method bids fair to be a commercial proposition.

## 97. Examination of Indian Cellulosic Materials.

P. N. BHARGAVA, Benares.

Forty different varieties of cellulosic materials from various commonly occurring trees, shrubs and herbs of U. P. have been examined and the following Chemical properties determined : (a) Percentage of Normal Cellulose by (1) The Classical Chlorination method of Cross & Bevan, (2) Norman-Jenkin's Sulphite process and (3) Modified Norman-Jenkin's process as discovered by the present author, (b) Percentage of Lignin, (c) Percentage of Resin, (d) Percentage of Reducing Sugars and (e) Copper Numbers of Normal Celluloses. Among the Physical properties determined are : (1) Average length and (2) thickness of the isolated fibres ; (3) The Microscopic study of the longitudinal and transverse sections of woods, shrubs and herbs and also of the isolated fibres both in ordinary and polarised light before and after staining with various agents.

Cellulose yields by method (1) vary from 37.9 to 90.8%, by method (2) from 49.9 to 92.2%, and by method (3) from 56.9 to 93%. The low yields by Cross-Bevan's process are due to the formation of oxidation and hydrolytic products by long chlorination and heating. The yields of lignin by Schorger's process vary from 14.5 to 30.3% and are always high owing to the absorption of sulphuric acid which cannot be easily washed off. The amount of resin by Sammeter's method varies from 0.19 to 4.46% and that of reducing sugars from 0.13 to 1.8%. The copper number determined by Schwalbe-Braidy method ranges from 1.18 to 11.2% for fibres isolated by Cross-Bevan's method, from 1.2 to 9.4% for fibres by Norman-Jenkin's method and from 1.02 to 8.5% for fibres by modified Norman-Jenkin's process. The low copper numbers obtained by the last method show that this process is highly satisfactory. Microscopic studies with magnification of 130 diameters, showed the range of fibre lengths to be from 2.46 to 9.44 mm. and that of their thickness from 10 to 40 (mm/100). The stained sections have shown tremendous contrasts in light and shadow and also in colour effects. The different fibres can be easily recognised by the various staining reagents and the microphotographs of the sections.

98. Estimation of  $\alpha$ ,  $\beta$  and  $\gamma$ -Celluloses, Hemicelluloses A and B and Lignin in some of the Indian Woods, Shrubs and Herbs.

P. N. BHARGAVA, Benares.

Twenty cellulosic raw materials including woods, shrubs and herbs have been exhaustively examined with a view to find out their suitability for the manufacture of paper and rayon for which raw materials having higher  $\alpha$ -cellulose content are required.

The  $\alpha$ - and  $\beta$ -celluloses have been determined gravimetrically and  $\gamma$ -cellulose volumetrically. The yields of  $\alpha$ -cellulose from the different fibrous raw materials have been found to vary from 51.4 to 92.5%, that of  $\beta$ -cellulose from 0.26 to 4.27% and of  $\gamma$ -cellulose from 1.41 to 12.7%. Cotton, *crotolaria juncea* and Chir, etc. are rich in  $\alpha$ -cellulose, bamboo, neem and sal, etc. in  $\beta$ -cellulose, and bagasse, sabaii grass, teak, etc. in  $\gamma$ -cellulose. Hemicellulose (A & B) were determined by the methods of O'Dwyer and Norris & Preece. The yields of hemicellulose A varied from 0.39 to 8.02% while that of hemicellulose B from 0.37 to 7.7%. The content of the former is high in bamboo, haldu, coconut fibres, etc. and that of the latter in bagasse, ketki, chir, etc.

For determination of lignin content, the methods of Schorger and of Norris and Preece have been tried. By the first method higher yields of lignin are obtained due to the absorption of sulphuric acid which cannot be easily removed. On the other hand, acid-free lignin is obtained by the second method which thus appears to be satisfactory. The yields of lignin by the first method vary from 3.65 to 20.86% and is definitely high in Bijaya Sal, Mango, Jute, etc.

From the results it is concluded that cotton linters, chir, bagasse, banana fibres, etc. can be used for the manufacture of rayon, and bamboo, chir, rags, moonj, sabaii grass, etc. are suitable for the manufacture of paper.

99. Preparation of Rayon.

P. N. BHARGAVA, Benares.

Celluloses derived from Indian raw materials have been tried for the production of rayon yarn in a model machine designed by Hagihara.

100. Isolation, Purification and Examination of Cellulose obtained from different sources.

P. S. VARMA and B. M. LAL, Benares.

With a view to find out the suitability of cellulose for the manufacture of synthetic fibres, pure cellulose has been obtained from various sources such as cotton, bagasse, wheat straw, paddy straw, jute hemp, neem wood, mango wood, deodar sawdust, etc. and the percentages of  $\alpha$ -,  $\beta$ -,  $\gamma$ -celluloses have been determined. Special attention has been paid to the yield of cellulose from different sources so that an approximate idea regarding the cost of production may be obtained. Nitro and acetyl derivatives have also been obtained from these celluloses.

101. Studies on the Sulphanilamide Drugs.

P. S. VARMA and N. SIVARAMAN, Benares.

With the growing importance of the sulphanilamide drugs, attempts have been made to prepare some of these drugs including the intermediates from raw materials available



in this country with a view to find out the conditions under which the best yields may be obtained. Sulphanilamide, sulphapyridine, sulphathiazole, sulphaguanidine and sulphadiazine has been obtained in good yields and the possibility of their manufacture in this country discussed.

#### 102. Preparation of Citric Acid from citrus fruits and of Tartaric Acid from tamarind.

P. S. VARMA and S. C. LOIWAL, Benares.

Citric acid (30 g.) has been obtained from *Citrus medica*, var, *Acida* (50 fruits) and tartaric acid (17—18 g.) from tamarind fruits (500 g.). The economic aspects on the manufacture of these acids are discussed. The rind of the citrus fruit gives also on steam distillation a sweet smelling oil (10 c.c. from the rind of 50 fruits) which is being further examined.

#### 103. Manufacture of DDT in India.

P. S. VARMA and (MISS) LILY GRACE, Benares.

For the manufacture of DDT all raw materials required are available in this country and can be manufactured much more economically than anywhere else in the world. The details of its manufacture have been worked out and its cost of production at a locality where raw materials are available in plenty has been calculated and discussed.

#### 104. Utilisation of waste vulcanised rubber in industry.

D. R. DHINGRA and S. N. GHATAK, Cawnpore.

Scrap waste vulcanised rubber from old rubber shoe soles, etc. containing 42—45% inorganic matter was distilled and the following products were obtained: 35.4% distillate, 58.0% residue and 6.6% uncondensed distillate. The distillate yielded 26.1% caoutchoucine of boiling point up to 200°C (9.2% on total), 34.6% heavy rubber oil of b.p. 200—300°C (12.2% on total) and 39.3% viscous tarry liquid (14.0% on total). The residue has 76% inorganic matter and 24% organic matter, thereby showing that 14% organic matter is highly polymerised and does not distill over easily. The distillate consists of compounds of polymers of  $C_6H_4$ -hydrocarbon.

Cracking of the fractions above 200°C was done by using aluminium oxide and pumice stone as catalysts and 16% of the distillate was of b.p. up to 200°C, 44% was of b.p. 200—300°C and the rest was viscous tar.

Light caoutchoucine can be used as denaturant for alcohol and the distillate b.p. 200—280°C has been utilised as a solvent for varnishes which produce almost as good a film as with white spirit. The solid residue can be used as a filler for paint industry after calcining and also as a filler for making vulcanised rubber.

Some antioxidants have been tried to prevent coloration and polymerisation of distillate on exposure to atmosphere and hydroquinone has so far been found to be the best antioxidant.

#### 105. Utilization of Ground Nut Meal. Part IV. Protein Adhesives.

U. P. BASU, Calcutta.

In view of the recent increased demand for industrial proteins attempts have been made to utilize proteins from vegetable sources such as ground nut meal (David Traill, *Industrial Chemist*, 1945, 21, 71; Ind. Patent, 29307 and 29891; Basu *et al*, *Ind. Med. Gaz.* 1945, 80, 398; 1946, 81, 75; Industrial News Edition, 1946, in press). It has been previously shown by Basu and Sen Gupta (*J. Ind. Chem. Soc.* 1944, 21, 389) that the protein as present in ground nut meal may be extracted out by alkali or salt solution, the properties of the protein isolated depending considerably on the type of meal and on the process of extraction. A solvent extracted meal has an advantage but it is not easily available. The red testa of the ground nut again transmits an undesirable colour to the protein. But it is difficult to remove the testa from the nut. Treatment with dilute alkali solution removes the soluble pigment, and the de-pigmented meal was then extracted with alkali at pH 8.5 and the protein was precipitated out from the filtered extract by means of sulphurous acid at pH 5.0. The protein isolated in this manner, is the protein found suitable for obtaining tacky and remoistening types of adhesives.

## 106. Evaluation of Natural Waters for Irrigation: Part I. Determination by Conductivity Measurement.

C. C. SHAH and R. D. PATEL, Baroda.

It has been shown that it is possible to determine the total soluble salts, calcium and bicarbonate content of natural waters by conductivity measurements only. The apparatus used is the Electrician's Megger and a glass U-tube 100 cm. long, having a diameter of 4.5 mm. The cell constant of such a cell is 74l. Three measurements are carried out: (i) The conductivity of the water is determined (A), (ii) A few drops of methyl orange are added, the water made acidic with a few drops of strong hydrochloric acid and then carefully neutralised by adding more water. The conductivity of the neutralised water is determined (B) and (iii) 5 c.c. of N/10 sodium carbonate solution are added to 50 c.c. of water, and the conductivity of the mixture is determined (C). The meter is directly calibrated for soluble salts, the relation used being soluble salts =  $31.5 \times$  Resistance in Megohms. Then

Soluble salts	=	(A) + 2.5 (B - A) ;
Bicarbonate	=	5 (B - A) ;
Calcium	=	59 - 1.1 (C - A)

## 107. Preparation of Activated Charcoal.

S. MUKHERJEE and S. BHATTACHARYA, Calcutta.

Activated charcoal has been prepared from shells of coconut and groundnut and from two Indian varieties of bamboo, using acidulated  $\text{ZnCl}_2$  or  $\text{CaCl}_2$ ,  $\text{NaOH}$ ,  $\text{H}_2\text{SO}_4$ , etc., pre-digestion and subsequent carbonisation at 600–800°C. The products have been tested for ash content, bulk density and adsorptive potency for methylene blue, iodine, acetic acid and caramel. All these raw materials have been found to yield activated charcoal of high adsorbing power. Generally speaking, pre-digestion with  $\text{ZnCl}_2$  and with  $\text{CaCl}_2$  gives rise to charcoals having the maximum adsorbing power, but very little activity is found in the product if the salt ( $\text{ZnCl}_2$ ) is removed by washing before carbonisation. Pre-digestion with  $\text{NaOH}$  or  $\text{H}_2\text{SO}_4$  yields charcoal of poor activity.

Increase in the proportion of  $\text{ZnCl}_2$  used for the preparation of groundnut shell charcoal results in a lowering of the adsorption of methylene blue, but no such change is noticed for coconut shell charcoal. The adsorption of caramel increases with the proportion of  $\text{ZnCl}_2$  for both types of charcoal, but more rapidly for groundnut shell. Caramel adsorption also varies with the bulk density, in an inverse manner, for charcoals prepared using  $\text{ZnCl}_2$  and  $\text{CaCl}_2$ . Iodine adsorption is high for charcoals prepared using  $\text{ZnCl}_2$ , while the adsorption of acetic acid does not appear to depend on the methods of activation employed.

## 108. On the Electrical Coagulation of Cane Juice Colloids and a New Sugar Technology.

D. N. GHOSH, Patna.

In the existing Double Carbonatation and Double Sulphitation processes of cane juice clarification, the colloids are removed partly by heat coagulation and partly by adsorption at a solid-juice interface, the solids being  $\text{CaCO}_3$  and  $\text{CaSO}_3$  respectively. This involves making the raw juice (pH 5.6) highly alkaline at one stage (pH 12 in the former process and pH 9 in the latter) by the addition of lime, when more of the suspended hemicelluloses and pectic bodies go in solution as they are more soluble in alkaline and hot media, and the heat coagulable albumins with iso-electric point at pH 5 are simultaneously rendered heat proof. The methods are thus imperfect and sugar factories at present have to be content with a rise in purity in the clarified juice of 2°–3° by the former process and 1° by the latter.

In the present investigation, the problem of clarification has been attacked from a purely colloid chemical point of view, inasmuch as the raw juice has been regarded as a suspension in sucrose solution of the lyophobic colloids, e.g., hemi-celluloses, waxes, mud, etc., peptised by the lyophilic colloids, e.g., the dissolved pectins and the albumins. According to the theory of peptisation the stability of such a colloid system should be destroyed resulting in automatic coagulation of all suspended colloids, as soon as the peptising albumins and pectins are removed by a process, which does not re-dissolve the suspensions at any subsequent stage. This has now been practically achieved by subjecting the cold raw juice to the action of direct current with iron plate electrodes, when the albumins and pectins, which are negatively charged, are removed, partly by direct contact with the anode plates, partly by charge neutralisation with the oppositely charged trivalent ferric

ions, generated by anodic corrosion, and partly by adsorption at the electrolytic gas-juice interface, as froth. The deposited layer of colloids prevent any loss of sucrose by anodic oxidation. This electrically treated juice has a pH 7.2 and it soon cracks and separates into a clear juice layer and a coagulated colloid layer, which is readily removed by filtration. Traces of iron and any residual albumins are now removed by acidifying the filtered juice to pH 6.8 with the addition of 0.03% of calcium superphosphate and heating, when a copious precipitate is obtained. This is removed by filtration, when the finally clarified juice is obtained, which is sparkling, almost free from colloids and coloring matter and has a rise in purity of 4°—5°.

#### 109. Distillation with Fibre Packed Columns: Part I. Benzene-alcohol Mixtures.

K. S. GURURAJA DOSS and N. S. JAIN, Cawnpore.

With a view to investigate the possibility of using packed columns for manufacture of absolute alcohol, fractionation of benzene-alcohol mixtures was studied in a glass-wool packed column. The apparatus consisted of a still, and a column with two sections, the top section being meant for removing any water present in the glass wool, alcohol or in the apparatus employed. An automatic decanter was used for removing the water. The vapours from the bottom and the top of the lower section (20" long) were analysed for the percentage of benzene by measuring the refractive index. The H. T. U. values were found to be about 0.9'. This low value indicates that it should be possible to have comparatively short columns for this process.

#### 110. Distillation with Fibre Packed Columns: Part II. Ethyl Alcohol-water Mixtures.

K. S. GURURAJA DOSS and MUJTABA HUSAIN, Cawnpore.

Fractionation of alcohol-water mixtures was studied using—

- (a) Glass-wool packed columns.
- (b) Patsan-fibre (*Hibiscus Cannabinus*) packed columns.

The former was studied at total reflux as well as at a reflux ratio of six. The reflux ratio was exactly controlled by an automatic proportioning device. The results show low values for the H. T. U. (2.5" to 4.5") and the possibility of shortening considerably the height of columns in distilleries and greatly simplifying their fabrication.

#### 111. Chemical Precipitation of Textile Wastes and Studies of pH Control: Part I. Sulphur Waste.

H. D. KARAM CHANDANI, Bangalore.

Although sulphuric acid is the most economical chemical to clarify sulphur wastes, the hydrogen sulphide production and the resulting poor effluent, eliminate the use of this chemical. Copperas is the best coagulant and gives a clear supernatant liquor without the production of odors. Little or no pH adjustment for discharge is required as the final pH is 8.25, thus more than compensating for the slight additional first cost. The sludge produced appears to be amenable to filtration.

The optimum precipitation of sulphur black waste appears to depend upon mixing, flocculating, and addition of chemicals, specially when study of settling is considered. A short rapid mix, followed by little or no flocculation, forms the most compact sludge when  $\text{FeCl}_3$  is the coagulant.

Addition of iron salts, prior to the addition of acids, reduces odors and favours better color removal. This is probably due to the formation of insoluble iron sulphide from the sodium sulphide. The removal of sulphide by this method reduces the source of odors and also removes the solution agent of sulphur dyes, resulting in better color removal.

Weighting of the sludge to produce more rapid settling is advantageous when only a short settling period is available. By the addition of inert material such as coal dust or sand, complete settling is obtained in one hour that under ordinary conditions requires

overnight or longer. Weighing may not be advantageous when long detention periods are available.

### Precipitation of Sulphur black dye under optimum conditions.

REAGENTS. (1.0 N).				Temp. C.	Inert material.		Color.	Sludge vol. to support volume in 1 hour.	Filtering time in seconds.
First.		Second.			Coal dust.	Sand.			
Name.	ml./ 100 ml.	Name.	ml./ 100 ml.						
FeCl <sub>3</sub>	8	HCl	19	65	2 gms.	4 gms.	75	1 to 1.7	29
FeCl <sub>3</sub>	8	HCl	19	65			100	1 to 1.5	160
Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	8	HCl	19	65	2 gms.		50	1 to 1.6	
FeSO <sub>4</sub>	5	HCl	19	65	2 gms.		100	1 to 1.4	23
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	10	HCl	17	65	2 gms.		250	1.9 to 1	48
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	10	HCl	17	65		4 gms.	350	1.6 to 1	50
FeCl <sub>3</sub>	20			22.5			400	1.3 to 1	80

### 112. Chemical Precipitation of Textile Wastes and Studies of pH Control : Part II. Kier Liquor.

H. D. KARAM CHANDANI, Bangalore.

For the treatment of kier liquors, alum alone, or alum and acid, produced the best results at low cost. Copperas and lime yield fair results with an effluent having a color of 300 p.p.m. This is the most economical combination. Carbonation by carbon dioxide and coagulation with CaCl<sub>2</sub> produced a poor effluent but offers possibilities as a cheap method for partial clarification. This latter method should find use with exceptionally strong kier liquors.

### 113. Chemical Precipitation of Textile Wastes and Studies of pH Control : Part III. Indigo Waste.

H. D. KARAM CHANDANI, Bangalore.

Best color removal from indigo waste-liquor was obtained with lime, next best with alum, and third best with CaCl<sub>2</sub>.

The most economical choice is the combination of lime and copperas even though adjustment of the final pH by means of sulphuric acid is necessary. The order of adding the chemicals and the time allowed for mixing and for flocculating are most important. For example, lime must be added first, followed by a mix, then copperas added, mixed and the composite flocculated for at least 30 minutes. The resulting sludge dewatered rapidly, forming a dry cake.

### 114. Glue and Gelatine : Fish Glue.

H. D. KARAM CHANDANI, Bangalore.

Fish meal thoroughly freed from soluble chlorides and macerated with alkali and acid yields good quality liquid glue. Boric acid and sodium fluoride increase the viscosity as well as preserve the glue liquid. Other things being equal the fish glue should be judged by its chloride content. Its ash content is high.

### 115. Studies on Konan bark—I.

K. SESHACHALAM CHoudary and Y. NAYUDAMMA.

Konan bark was mainly used along with Avaram bark in the tanning of East Indian tanned Kips. in South India. After the first War Wattle imported from South Africa it was introduced into the industry. With the cessation of trade relations with South Africa, South India is not importing any Wattle bark. Work has, therefore, been taken up to make a complete study of this bark, in order to make it more popular in the South Indian tanning.

The bark contains about 10% of tannin. Leach liquors of different barkometer strengths were analysed. The completeness of leaching the bark in the cold was also studied. It is found that in 2 days, 90% of the total solubles, 80% of the tannins and 94% of the non-tannins are extracted. It is interesting to find that during the cold leaching of this bark, the non-tannins are readily extracted.

The bark was extracted at temperatures from 30 to 100°C. 80 to 90° appears to be the optimum temperature of extraction from the point of view of tannin content. At ordinary temperature, all the non-tannin is extracted. Leaching at the ordinary temperature appears to suffice for the South Indian tannage.

#### 116. Avaram bark.

K. SESHACHALAM CHOUDARY *and* Y. NAYUDAMMA.

The bark is used solely in the tanning of skins meant for export to foreign countries. This bark is obtained from the shrub by stripping the bark from the twigs. The mere cost of stripping the bark has been found to vary between 40 & 60% of the total cost of production of bark at the assembling centre. Experiments were conducted to see if the unstripped twigs could not be used in the place of stripped bark, for the tanning of skins. The bark contains 18.52% of tannin as against 4.51% in unstripped twigs. Leach liquors were prepared from these. Skins were tanned with the unstripped twigs and the bark according to the South Indian Tannage. The quality of the leathers obtained were similar. Since the weight of the bark is about 20-23% of the twigs it will not be economical to transport the twigs over long distances. But the unstripped twigs can be used in the place of the bark in places where the twigs could be readily obtained. This might help in the development of the South Indian tannages on a cottage basis in the villages.

#### 117. A compound for lining and sealing containers.

KARIMULLAH, UMA SHANKAR *and* G. S. TEWARI, Delhi.

Earliest work on can sealing dates back to the twenties of the last century. Rubber rings came in use first, then followed the cheaper and better benzene solution of rubber, and paper gaskets. These were, however, defective, being inflammable, faulty in operation and breaking down in service. To-day these have been superseded by latex compositions, which are automatically applied on can covers and to caps to give elastic, tightfitting and lasting films, chemically inert to the contents.

The latex compound should have sufficient fillers to produce a heavy, plastic film and should be of such consistency as to be capable of being forced through a nozzle on to the sealing surface, treating 120-500 covers per minute. The pressure, size of nozzle and the speed of application depend on the thickness of the film desired, which in turn depends on the service required. The wet film is dried during 6-8 minutes, then worked.

The compound is not yet manufactured in India although several foreign patents mentioned. A latex composition has been worked out which meets the requirements mentioned above and is going to be manufactured on commercial scale. This composition consists of about 25% solid matter, 15-17% being rubber, and the rest fillers, etc. The fillers, etc., are made into a colloidal paste and added to stabilised latex. The compound gives a tough, elastic film, stable to vegetable ghee, etc., and not imparting colour and odour to the latter. A patent application has been filed.

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## SECTION OF GEOLOGY AND GEOGRAPHY

PRESIDENT : PROF. C. S. PICHAMUTHU, B.Sc., Ph.D. (Glas.), F.R.S.E.,  
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### A. GEOLOGY

#### Mineralogy

1. On some minerals in Rohtas limestones from Shahabad District, Bihar.

R. C. MISRA, Lucknow.

During the course of visits in the years 1943 and 1945 to limestone quarries south of Dehri-on-Sone, near Rampur ( $83^{\circ} 59' - 24^{\circ} 47'$ ), and Banjari ( $83^{\circ} 59' - 24^{\circ} 40'$ ), fluorspar, galena and limonite, showing the characters of stilpnosiderite, have been observed in the Rohtas limestones.

*Fluorspar*—The Rohtas limestone at the base of Vindhyan scarp running almost parallel to the Sone River in the District of Shahabad is extensively quarried for use in the Cement Factories or lime-kilns.

At the above mentioned localities (particularly at Banjari) it is intersected by numerous veins of calcite. The fluorspar crystals are deep blue or purple in colour, and occur in the white veins of calcite. Crystals showing cubic faces measuring up to 1 cm. sq. are quite frequently observed.

*Galena*—A few crystals of galena were also observed in greyish black limestone at Banjari.

2. Diaspore with pyrophyllite from Hamirpur District, United Provinces.

R. C. MISRA and C. P. SOOD, Lucknow.

In a paper published elsewhere one of us (R. C. M.) has shown that the long known deposits of Steatite of Hamirpur District, United Provinces, are deposits of pyrophyllite. Pyrophyllite occurs at four localities, *vis.*, Gorahri ( $79^{\circ} 37' - 25^{\circ} 27'$ ), Turra ( $79^{\circ} 27' - 25^{\circ} 29'$ ), Girwar ( $79^{\circ} 29' - 25^{\circ} 39'$ ), and Pahari Garhi ( $79^{\circ} 31' - 25^{\circ} 32'$ ), associated with quartz reefs traversing Bundelkhand-granites and gneisses.

At Gorahri where pyrophyllite is mined, and pots and vases are made, diaspore was discovered by the first author. The mineral occurs in the form of geode like bodies within veins of pyrophyllite. Three distinct forms are noted: (1) Massive compact nodular form, individual crystals not seen; (2) Clusters of radiating purple crystals with a pearly lustre; (3) Well-developed prismatic crystals arranged round a core of impure pyrophyllite.

The mineral has been analysed and other physical and chemical properties studied.

As far as the authors are aware, diaspore in the form of well developed crystals and as an independent mineral has not been recorded from India so far, and its association with pyrophyllite is probably recorded for the first time in geological literature.

*Stilpnosiderite*—This mineral is deposited in the spaces between crystals of calcite. It shows prominent striations and has a jet black color, and shows tendency towards crystallisation.

#### Petrology

3. Bezwada gneiss, khondalite and leptynite.

M. S. KRISHNAN, Madras.

There are various areas of garnetiferous gneisses in the Peninsula which have been called by different names by previous workers. They consist generally of quartz, orthoclase, microcline, acid plagioclase and garnet, with subordinate sillimanite and graphite, and occasionally some calcite, magnetite, rutile, pyroxene, etc. They are now generally known under the name of *Khondalite*, originally introduced by Dr. T. L. Walker for these rocks in the Kalahandi State. In the Kistna district they are known as *Bezwada*

gneisses which are generally rather rich in felspar (murchisonite) while in the Vizagapatam district and Vizianagram Estate they have been called *Kailassa gneiss* and *Vizianagram gneiss* respectively by Dr. W. King. In the type area of charnockites at Pallavaram near Madras city the garnetiferous gneisses, called *Leptynites*, have been considered by Sir Thomas Holland as derived from charnockites, but there is no clear evidence of such transformation in the larger masses; indeed the garnetiferous gneisses appear to be a distinct series of foliated rocks to which the charnockites show intrusive relationship.

In the above districts and elsewhere (e.g., Salem and Tinnevely) the garnetiferous gneisses are generally associated with charnockites and in some places with crystalline limestones. They are para-gneisses which have been subjected to high grade metamorphism. These and the similar gneisses in Ceylon and Burma may all possibly belong to one geological age and there is little doubt that, despite some local variations, they are all of similar character.

#### 4. A study of a pyroxenite from Kondapalle, Madras Presidency.

T. N. MUTHUSWAMI and K. VENUGOPAL, Madras.

The Hypersthene shows the following optical characters.

X=Hyacinth Red.  
Y=Yellowish Green.  
Z=Grey.  
 $N_g - N_p = .011$ .  
R. I. for  $N_g = 1.7211$ .  
Optically negative.  
 $2V = 52^\circ$  to  $54^\circ$ .  
Optic plane, 010.  
Schillerization, well developed.

The norm calculation is found to show a deficiency of 12 per cent. of the orthosilicate molecule.

En100 —49.09;	Di100 —13.23;
En+Fs	Di+Hy

These features agree with the general characters of orthopyroxenes. It is suggested that the absence of the diopsidic lamellae in this mineral is due to less of CaO content than in the hypersthene of the country rock in which diopsidic lamellae are formed. The Niggli values are given and the origin of the Hypersthene is traced to the orthoaugite magma type of Niggli. The Katanormative minerals are not also of the saturated ones. The authors thus show that with reference to this mineral also there is a deficiency in silica both in the C. I. P. W. norm and Katanorm. A deficiency of silica in the C. I. P. W. norm is considered as a common feature of orthopyroxenes by Fenner. The mineral has the composition En 49 Of 51 and is a Ferro-Hypersthene.

Metamorphic reactions in the minerals of the country rocks are also described.

#### 5. On charnockite rocks of Palamau District, Bihar.

K. P. RODE, Dalmianagar.

The author along with Mr. Raghuji Verma, B.Sc., working under him as a research student visited and studied an area of about 60 sq. miles in the valley of the Auranga-Koel rivers a few miles south and SE. of Daltonganj. A large collection of rock-types was made of which over 50 representative rocks were studied under the microscope.

Megascopically some types were found to be similar to charnockites and this was confirmed by the microscopic studies which showed common occurrence of hypersthene in rocks of acid to basic and ultra-basic composition and of general granulitic textures.

Besides these typical igneous rocks, were also found para-schists of the Khondalite facies in intimate association. This proves the occurrence of the Eastern Ghat Facies in the Chota Nagpur region.

The field and microscopic studies have shown that hornblendic basic and ultra-basic magmas have intruded into the granites, gneisses and Khondalitic schists along tectonic zones permeating widely into the intruded rocks. Hornblende has altered into hypersthene and at times into olivine. The intrusive magmas and solutions have brought about basification and charnockitization of the acid granites and gneisses giving rise to acid and intermediate types of charnockites and also to a number of mixed types from the Khondalitic para-schists. The Charnockites as seen in this as also in some other areas do not constitute a normal differentiation series nor are they the products of



assimilation of Dharwar sediments or their granitisation, nor does it also appear that metamorphism of either plutonic, regional or contact type has played any decisive role in the recrystallisation of the various mineral aggregates of the Charnockitic suite of rocks. The most important process responsible for the formation of these rocks appears to be the intrusion and injection of hornblende magma into and consequent basification of basement granitic rocks and the transformation of the hornblende into hypersthene.

This would show that the petrographic Charnockite Province has no geographical limits and that charnockitic rocks can be expected, as they are actually found, in widely distant regions on the earth's surface. They are connected with the oldest orogenesis on record and as such are confined to the oldest Archaean shields of the earth.

## 6. Study of granitisation of schistose rocks from Krishnarajasagar, Mysore.

M. R. SRINIVASA RAO and M. G. CHAKRAPANI NAIDU, Bangalore.

Granitisation has been a widespread process in the Archaean rocks, and many of the biotite gneisses intimately associated with them are the outcome of acid injections into schistose formations. A large number of areas in Mysore afford clear indications for such a conclusion. One such typical area is situated in Krishnarajasagar near Mysore. This area has been studied recently, and evidences have been gathered which unmistakably show that there was a regular lit-par-lit injection of felsic material along the planes of schistosity of the country rock, namely, the hornblende schist. The result has been the development of biotite gneisses showing typical alternate banding of felsic and mafic material comparable to the migmatites described by Sederholm from Finland. A large number of field photographs and microphotographs are included to demonstrate the different structural and mineralogical peculiarities.

## 7. Spotted shales from the Cuddupah formation.

M. R. SRINIVASA RAO and C. GUNDU RAO, Bangalore.

A series of most interesting rocks has developed in the Cuddupah formations in South India belonging to low grade metamorphism. These rocks are distributed throughout the Cuddupah basin, from Pulivendla in the south to Kurnool in the north, a distance of nearly 100 miles. In this region shales of different types have come in contact with basic igneous rocks like dolerites and basalts which occur in the form of sills and lava flows. These rocks can be studied to advantage near Bedadoor, Kaverisamudram and Royalcheruvu. A large number of specimens have been collected from these localities and a detailed study reveals the development of different varieties of spotted rocks comparable to the standard 'Knotenschiefer' of continental geologists. Sketches and microphotographs are included to illustrate the structural features in these rocks.

## Stratigraphy and Palaeontology

### 8. On the occurrence of the algal genus *Dactylopora* in the limestones from Assam.

SRIPADRAO KILPADY, Nagpur.

The discovery of the algal genus *Dactylopora* Lamarck is reported from the limestones immediately underlying the Cherra Sandstone—West Cherrapunji, in the Khasi Hills, Assam. This is the first time that an undoubted form of this genus has been recognised in the Eocene formations of India. A comparison of the Assam form is made with the type specimen *D. cylindracea* Lamarck from the Eocene of the Paris Basin and its importance is discussed.

### 9. The Age of the Cherra Sandstone.

SRIPADRAO KILPADY, Nagpur

From a study of the Corallinaceae in the limestones of the Sylhet Stage overlying the Cherra Sandstone (Tura Stage) in the Khasi Hills, Assam, the upper age limit of the Cherra Sandstone was concluded to be middle Eocene (K. S. Rao, 1943, *Proc. Nat. Acad. of Scs.* Vol. 13, Part 5, pp. 265-299). The evidence of the Corallinaceae in the algal limestone below the Cherra sandstone was not conclusive. It was expected that the study of the Dasycladaceous algae found associated with the Coralline algae would throw more light on the exact age of the Tura Stage. A detailed study of the Dasycladaceae just completed, has fully justified this expectation. The evidence available from this study favours a Lutetian-Auverian (Laki) age for the Cherra Sandstone.

## 10. Evidences of the existence of life during the Vindhyan Period.

R. C. MISRA, Lucknow.

The following observations are based on the work done near Karwi, Banda District United Provinces, and Banjari, Shahabad District, Bihar.

*Carbonaceous matter.*—The Rohtas limestones quarried west of the railway station of Banjari are occasionally dark greyish-black in colour, and some shaly bands are almost black in colour. Thin sections of the limestones show presence of abundant carbonaceous matter distributed throughout the rock in the form of streaks and patches. There are reasons to believe that the carbonaceous matter is of organic type and of plant origin, although so far definite structures have not been observed.

*Spiral impressions.*—These impressions are seen on thinly bedded clayey limestones at Rampur and Banjari. The impressions may represent fossils of coiled worms. The maximum diameter is 17 mm.

*Glaucinite and Mudstone pellets.*—A study of thin sections of glauconite limestones from Lodhwara Hill north of Karwi (25° 13'—80° 55') shows that the glauconite and mudstone pellets are definitely infillings of organic structures.

## 11. On the two species of foraminifera figured by Kossmat (1897) from Pondicherry, S. India.

S. R. N. RAO, Lucknow.

Kossmat's *Amphistegina* is recognised to be a *Miscellanea* and his *Orbitoides* to be a *Discocyclus*. Both these come from the *Nerinea* beds (with *Hercoglossa danica*) considered to be Danian in age. The South Indian species of *Miscellanea* and *Discocyclus* are different from those recognised in India and the two genera are not present in the neighbouring Danian Niniyur beds of Trichinopoly. In the light of the evidence now available, the *Nerinea* bed is considered to be the stratigraphical equivalent of the Hangu Shales of the Ranikot sequence. It is interesting to note that a form very close to *Hercoglossa danica* occurs in the Palaeocene of America.

12. The distribution of the Eocene alga *Distichoplax biserialis* (Diet) in the Indian region.

S. R. N. RAO, Lucknow.

The geographical and stratigraphical distribution of this alga is discussed and it is shown that it is widely distributed in the Palaeocene and Lower Eocene beds of India. Because of its simple and characteristic structure the fossil is easily recognisable in thin sections of limestones and is an useful fossil to micropalaeontologists.

## B. GEOGRAPHY

## Physical Geography

## 13. Blind rivers of the Damodar Delta.

S. C. BOSE, Calcutta.

Damodar enters its delta stage after bending sharply below Burdwan towards the south. From here distributaries branch out from it. No less than seven of them have their names prefixed by "Kānā", which literally means blind. The pattern, character, regime and utilization of these streams is discussed in the paper. Evidences such as abandoned ghats, wrecks of boats, old temples and ruins, along some of these streams show that they were big rivers in the past. Now many of them have been reduced to chains of stagnant pools, choked by weeds, grasses and water-hyacinth. Even so, upon this meagre supply of water depend chains of market gardens and potato fields spreading along their banks. Previous attempts to revive them have failed and a fresh attempt is contemplated as a part of the new Damodar Project.

## 14. The evolution of the Marble Falls and the Geomorphology of surrounding region.

N. DE, Calcutta.

The evolution of the Marble Falls is involved in voluminous controversy. Geologically speaking, Narbada is a very recent river. Hence some authorities are of the opinion

that the origin of the Marble Falls and the gorge, it has cut, is quite recent. Others favour the idea that the gorge is a rift valley.

The gorge extending more than two miles could not have been formed recently in marbles. There are definite proofs of the existence of the gorge before the deposition of the older alluvium in the Narbada Valley. A consequent stream flowed northward with subsequent tributaries. Faulting of the Marble and the tilting of the western component to the South followed by uplift of more than 40 feet, rejuvenated the river system, and thereby increased the corrosion. The Eastern component of the Marble, then got tilted towards the east. The subsequent tributaries of the east were rejuvenated. Thus the gorge actually took a right angular bend in this way. Then followed a period of subsidence and sedimentation. The limit of deposition is the fault line. The Narbada flowed on the Older Alluvium as a consequent stream. In course of time Narbada corraded the alluvium and began to flow on the Marble. But a subsequent stream developed along the former gorge and captured Narbada. The gorge forming processes were intensified. There is definite marks of capture quite near the present site of the Falls.

The inter-action of structure and stage has produced a number of distinct geomorphological features. They are classified into—Marble Topography, Gorge, Older Alluvium, and Panchabati Region. Other structural elements, are steatite and quartzite veins, and dykes.

It is suggested that this region should be developed as the national park of India, In beauty and serenity, it is without a rival in India. India's natural Taj is the Marble Falls.

15. A geographic study of the soil conditions in the sub-montane plain of North Bengal.

N. R. KAR, Calcutta.

The paper embodies the results of observations made by the author during a reconnoitry tour over the entire sub-montane tract of North Bengal, with a view to studying the nature and development of soil over the area, as well as to assess the problem of grouping them under an International scheme of soil classification.

Under the geographic considerations of the area, comprising the whole of Darjeeling, Terai and Jalpaiguri Duars, the author has discussed the geological building up of the area together with the origin of parent material, the textural quality and its variation in surface soil, the climatic régime dominating over the land, the condition of drainage as well as the agricultural history of the area, in so far as they all influence the pedogenic processes leading to characteristic soil profiles.

A detailed study of a number of soil profiles scattered all over the area brings into light the following salient facts. The surface soil is in each case sandy, there being a textural gradient of coarse and gravelly sands to fine silty loam from north to south coincident with the topographic gradient of 1,000 ft. to 200 ft. from north to south. The surface horizon ( $A_1$ ), either under forest litter, or under plough, consists of sandy to silty loam, all coloured gray black, with a fairly high content of partially decomposed organic matter, which is obviously higher and uniformly distributed in the top soil under forests and tea gardens. Reaction is invariably acidic, the pH value varying from 3 to 4 in the extreme north and gradually increasing southwards. Humus accumulation even under dense forest is very little, the process of humification being very slow due to high temperature of hot weather season with consequent drying up of soil, inhibiting anaerobic humification, free and favourable aeration through the light sandy soil and the necessary moisture in it for the completion of destructive and oxidative decomposition of organic matter.

After a detailed study of the subsequent horizons in all the profiles, the author arrived at the following conclusions. The soil over the whole region of Terai and Duars comes under the 'pedalfer' group of soil, as defined by Marbut and within this region a number of sub-groups coalesce into each other. In the northern fringe of the Duars along the foothills, the soil is gray-brown podzolic soil, showing a gray-white eluviated 'bleich erde' layer ( $A_2$ ), underlain by a thin accumulation of colloidal organic matter ( $B_1$ ), resting on a gray-brown to yellow-brown sandy loam. In the north of central Duars as also in the northern Terai, the soil profiles resembles that of Brown forest soil or 'Braun erde' of Ramann where thick gray-brown or maroon coloured sandy loam just underlies the organic surface layer. All other profiles over the whole region invariably belong to the Yellow earth group of soils of sub-tropical latitude, showing a thick bright yellow sandy layer (B) underlying a thin organic layer (A) and overlying the grayish parent alluvia (C). In all cases the thorough leaching of sesquioxides from upper horizons together with their hydration and precipitation in lower horizons, with consequent intense

colouration, is the most conspicuous feature. This Yellow earth of Terai and Duars forms a transition group between the Gray-brown podzolic soils of sub-Himalayas in the north and the sub-tropical Red earth of Chota Nagpur and west Bengal in the South.

## 16. Structure of the Iran Plateau.

M. B. PITHAWALLA, Karachi.

Following on the scheme of physiographic divisions of the Iran Plateau (*Vide Proc. 33rd Ind. Sc. Cong. III. Abstracts, P. 10*), the author has discussed, in the present paper, the origin, structure and stages of evolution of the Iranian land mass. The hydrographical features and the nature of rocks and minerals, particularly the petroleum deposits, have also been referred to and the way is prepared for a regional geography of the entire plateau, with special reference to the inter-relatedness of the environment and human activities for a long period of 5,000 years.

## 17. Climatology of the Upper Ganges Basin.

D. R. SINGH, Meerut and M. B. PITHAWALLA, Karachi.

The paper is a continuation of the regional study of the Upper Ganges Basin, the physiography and natural vegetation, etc., which were dealt with in the sessions of 1943 and 1944.

The Basin presents contrasts in meteorological conditions. Within its boundaries temperatures soar up to 120°F in summer and come down to near freezing point in winter in some places.

There is one major climatic feature which is common to the whole of the region under study, and this is the South-west Monsoon which advances into the region by about the 3rd week of June and withdraws by the end of September.

In December and January the weather is affected by a series of western disturbances which cause rain from 1" to 5" and are sometimes followed by cold waves.

The Basin is divided into eight climatic regions after securing data from some eleven stations as 35 years (1910-1944) averages of various climatic elements are calculated.

The paper is illustrated with necessary graphs, sketches, etc.

## Economic Geography

### 18. Power development in India.

G. KURIYAN, Madras.

The paper deals with the unsatisfactory manner in which power development has taken place in India, utilising not the abundant resources in water power, but the meagre resources in coal which ought to be carefully conserved. The disadvantages of the present method are discussed and it is suggested that an all-India Hydro-Electric Grid be created, not merely to supply the present power requirements of the country, but also to foster the growth of industries.

### 19. Cultivable waste lands of the Godavari Region.

V. L. S. P. RAO, Calcutta.

The paper deals with the nature of the cultivable waste lands of the Godavari region and the different factors contributing to their extent and variation. Possibilities of utilization and future programme have also been discussed. In the year 1791 nearly 40 per cent of the total land was cultivable waste land in the region; in 1941 the figure came down to 28 per cent. Out of the 28 per cent of cultivable waste land, 20 per cent was cultivable waste other than fallows, and the remaining 8 per cent was current fallows. On an average there are 520,308 acres of cultivable waste other than fallows and 194,381 acres of current fallows. In the whole region maximum encroachment on cultivable waste land took place in the Western Godavari Plain (Ramachandrapur taluk).

Basing on the ratio between the cultivated area and the cultivable waste land, especially in the sandstone region and the delta, one may be tempted to suggest the cultivation of a part of the cultivable waste. A preliminary pastureland survey revealed that this is not possible. The cultivable wastes of the Godavari region chiefly consist of (1) the fallows, (2) the salt-wash lands with either defective drainage or inadequate

water facility, or both, and (3) the pasture lands for cattle. Some of the waste lands consist of sub-marginal lands, e.g., foothill zones of Gokavaram, Eleswaram and Rantulapudi firkas.

Excessive fragmentation, differences in tenure and land income, and the absence of basic data relating to the character and extent of waste lands in different natural regions limit the execution of systematic pasture land programmes. Experiments in improvement and management and collection of the necessary basic data should precede any pasture land programme.

### Human Geography

#### 20. A demographic study of the Upper Damodar Basin.

S. C. BOSE, Calcutta.

The Upper Damodar Basin includes nearly the whole of Hazaribagh District, the northern half of Manbhum and small portions of Santhal Parganas, Palamau and Ranchi. The distribution of population is affected by topography, forest cover, fertility, soil erosion, accessibility, mineral exploitation and industrial development. Three cartographic methods, namely choropleths, isopleths and the dot method, have been used, and actual patterns of population in various type areas have been drawn. The most remarkable features are the blanks in Parasnath, Lugu and other hill areas, the rapid change of Jharia from a sparsely populated to a densely inhabited area, and the peculiar inverted patterns of population in the Upper Barakar Valley. With the opening up of new coalfields, construction of new roads and railways, and electrification and industrialization following the successful completion of the new Damodar Project, the density and pattern of population is bound to undergo a rapid change.

#### 21. Climate of Calcutta and human energy.

P. C. CHAKRAVARTY, Calcutta.

The discrepancies between thermographs and barographs of the city of Calcutta have been explained in this paper taking into consideration the relative humidity graphs of the city for the corresponding periods. Windroses and relative humidity graphs when studied with relevant temperature and pressure conditions of the place account for the high precipitation from June to September when a stimulating rainy season sets in. Winters are mild with moderate relative humidity having occasional rains. Sultry summers are greatly modified and become sensible with frequent showers in the afternoon. This marine monsoonal climate together with economic and social controls are responsible for making it a cosmopolitan city with immense activities and human energy. Birth rate is high but excess deaths bespeak of social, economic and educational influences over population. The climate of Calcutta is enervating in summer, but stimulating though not invigorating in winter.

#### 22. Development of 'Culturology' as an offshoot of the science of geography.

M. B. PITHAWALLA, Karachi.

In this paper the author has suggested a technique for the development of a new branch of Geography, which he calls "Culturology". Apart from taking geography as a science only of economic values, he aims at the inner aspects of culture, born of regionalism. This would involve not only the inter-relatedness of man and nature in definite physiographic regions in the ordinary course, but also the interaction of the natural environment with the inner and higher nature of man living in them. So the geography of a particular region becomes the planned programme of nature in the deeper psychological sense and for the spiritual uplift of humanity.

Why does a particular race or a community of human beings happen to inhabit a particular region? Is there any divine purpose of the place factor in the evolution of mankind? If so, what is that purpose and how can we discover it? This will be the domain of Culturology, a synthetic process.

The author believes that if there is any geographical unit most likely to produce unity out of diversity of race, it is India, and if there is any particular physiographic region of India most suitable for a starting point for this process, it is the Upper Ganges Basin. It is the very heart of India and in the right place. He gives both scientific reasons and historic proofs to prove this statement. Such a geographical synthesis can be easily encouraged by our Indian Universities, so that the Personality of India can easily emerge from it and concord, not discord, would be the result.

Regionalism is always powerful. There is generally an initial conflict of our varied cultures at the first impact. But with a carefully planned programme of acculturation, such clashes can be avoided and the unification not only of India and Asia but of the whole world can be effected. Only narrow provincialism, born of artificial political boundaries, is the root cause of the trouble all over the world. It must be removed and replaced by regionalism.

### 23. The Godavari Hill tribes (The Koyas and the Reddies).

V. L. S. P. RAO, Calcutta.

Origin and classification of the Godavari hill tribes, their past glory, present slavery, environment and habitat, food and other requirements, customs and manners and their tenure are dealt with in this paper. According to tradition these tribes were driven away from Bastar plateau (Central India) in the 17th century by famine and internal struggles. The tribes can be classified into (1) Gutta Koyas of Dumma Konda region (2) Koyas and (3) Reddies of Papikonda and Rampa regions. The Godavari Koyas and Reddies are being dragged into the windward side of the modern vicious economic system. Direct super-imposition of stagnant agricultural pattern on the hill tribes is a false step. The Godavari Agency Economic Development Scheme needs modification; the chief solutions are to develop more of market-garden-culture, to introduce "Taungya" method (raising forest crops in conjunction with agricultural crops) *e.g.* Pamuleru Valley, encourage poultry keeping and cattle breeding and to prevent the tribes from being exploited by traders and contractors through the Resources Utilizational and Distributional Syndicates to be formed.

## SECTION OF ZOOLOGY AND ENTOMOLOGY.

PRESIDENT : DR. G. D. BHALERAO.

### Cytology.

#### 1. Chromatin elimination and the Ciliate Macronucleus.

B. R. SESHACHAR, Bangalore.

In Protozoa buds extruded from the macronucleus disintegrate in the cytoplasm. These extrusions really mean a distribution of nucleic acid in the cytoplasm. Large amounts of cytoplasmic nucleic acid have, in fact, been detected in the cytoplasm of a number of ciliates. An examination of *Epistylis* (Peritricha : Epistylidae) has convinced the author of the correctness of these assumptions and leads him to believe, that at every conjugation, the disorganization and disappearance of the macronucleus is another such process of chromatin elimination from the nucleus and distribution in the cytoplasm. The re-formation of the macronucleus after conjugation by the "enlargement" of one of the descendants of the synkaryon, is merely a re-acquisition of this nucleic acid from the cytoplasm, which had been earlier distributed in it. It is suggested that the need for the nucleic acid in the cytoplasm at the time of conjugation is indicated by the great overhauling to which the cytoplasm of the ciliate is subjected and in the general far-reaching effects which conjugation is said to have on the individual and the race.

#### 2. The micronucleus of *Epistylis*.

B. R. SESHACHAR and K. V. SRINATH, Bangalore.

An examination of two species of *Epistylis*, *E. articulata* and *E. plicatilis*, showed that the micronucleus of these two species differed markedly in their staining reactions. In both, the macronucleus was a large band-shaped body brilliantly stained with standard nuclear stains, especially with Feulgen. The micronucleus of *E. articulata* is a small spherical structure situated close to the macronucleus and also taking up stain intensely. But that of *E. plicatilis* gave a negative reaction with Feulgen and was almost completely lost to the view. Selective staining with other standard nuclear stains, especially Feulgen associated with Methyl-green, showed that the micronucleus in this species also was a spherical body but whose nucleic acid was different from the micronucleus of *E. articulata* in both content and type. Seeing that Feulgen is selective to one type of nucleic acid—the desoxyribose nucleic acid—the negative reaction which the micronucleus of *E. plicatilis* gives to Feulgen makes us conclude that there is a great paucity of this nucleic acid in the nucleus. It is also probable, on the analogy of the metazoan nucleus, that this negative reaction is indicative of a large protein content in the nucleus associated with ribose nucleic acid. In any case, the fact, that the micronucleus which is to form chromosomes during division, should be associated with either protein or ribose nucleic acid, while the macronucleus which is not supposed to form chromosomes shows desoxyribose nucleic acid, is very interesting.

### Protozoology.

#### 3. Observations on the transmission of theileriasis to their progeny by the ticks, *Hyalomma ægyptium* Neumann.

H. N. RAY, Mukteswar.

Experimental evidence is put forward to show theileriasis, due to *T. annulata* in calves, could be transmitted to the progeny of the infected *Hyalomma ægyptium* and that the transmission of the parasite is only effected in the adult stage.

### Helminthology.

#### 4. Conception of paruterine organs in the cestode genus *Avitellina*.

M. AMIN, Izatnagar.

The structure and development of paruterine organs in the cestode genus *Avitellina* is still insufficiently known in its details. Previous workers, with the single exception of Gough (1911), appear not to have correct idea either of the paruterine organ or the uterus. They designate the uterus, in the mature and pregravid segments, as "paruterine organ" and the developing paruterine organ (actual) as only a part of that structure. Thus the developing paruterine organ has been described as "bladder" of the "paruterine organ" (uterus) in *A. lahorea*, *A. woodlandi* and *A. latia*, and as "median thick walled forward projection," "pouch," "dense fibrous pad" of that organ in the case of *A. sudanea*, *A. centripunctata* and *A. chalmersi*, respectively. This misinterpretation has caused some confusion in the taxonomy of these species as most of the species in this genus are characterised mainly by the form of the so-called paruterine organs. The author, by a study of entire specimens of these species, traced the development of these organs, and he observes that the paruterine organ is distinct from the uterus, although it develops in connection with the latter. In this paper, he has proved this fact by describing the development of the paruterine organs.

#### 5. Notes on some helminths in the collection of the Zoological Survey of India.

B. S. CHAUHAN, Benares.

The paper deals with some helminths recently collected or received for identification. Most of the specimens are poultry worms and fish parasites. Anatomical variations, found in specimens of *Ganada clavia*, from the intestines of the fish *Clarias batrachus* from Nagpur have been recorded. Notes have been added on *Isoparochis hypselobagri*, an anoplocephalid Cestode, *Paronia* sp. from fowls from Gondia (C.P.), *Raillietina* (*Raillietina*) *tetragona*, *Raillietina* (R.) sp., *Cotugnia cuneata* var. *nervosa*, *Hymenolepis gracilis* from ducks from Nagpur, *Hymenolepis oweni*, *Hymenolepis* sp., *Polydelphis sewelli* and *Porrocaecum* sp. *Ascaridia galli* has been recorded from a goose in Nagpur. An interesting case of a large-scale mortality of the fish, *Wallagonia attu* (Bl.), which harboured the nematode worm, *Porrocaecum pristis*, has been reported.

#### 6. On the life-history of *Trichuris ovis*, with experiments on the embryonation and extra-corporeal hatching of the eggs of *Trichuris* sp.

P. G. DEO, Izatnagar.

One of the kids artificially infected with *Trichuris ovis*, which died 61 days after infection revealed the presence of 362 worms in the small intestine, 85 worms in the large intestine and 466 worms in the cæcum, all being immature. The second kid which was slaughtered, along with the control, 136 days after infection showed 135 mature worms in the cæcum, the control being negative.

In *Trichuris* sp. it has been found that eggs took approximately the same period for embryonation in soil, as they did in water cultures. The effects of immersion in saturated salt solution and centrifugalisation upon the embryonation of eggs and experiments on the extra-corporeal hatching of embryonated eggs in different media, have also been discussed. The eggs failed to hatch in the media of saturated salt solution, sugar solution, dilute potassium permanganate solution, artificial gastric juice and artificial pancreatic juice, though they were kept in them for more than three weeks. About 4% eggs could hatch when treated with 5 c.c. of artificial gastric juice for 20 hours and then treated with 5 c.c. of artificial pancreatic juice for 24 hours at 97°-98°F.



## Crustacea

### 7. First record of occurrence in India of the ancient suborder Phreatoicoidea (Crustacea : Isopoda).

B. CHOPRA, Benares.

With the exception of three species from South Africa, all the hitherto known species and varieties belonging to a large number of genera of the Phreatoicoidea are inhabitants of freshwaters of Australia, Tasmania and New Zealand. Many of the species live in subterranean waters. Recently, some members of this suborder have been found living in wells in some towns in the U. P., and this is believed to constitute the first record of their occurrence in any part of Asia.

The suborder Phreatoicoidea appears to be an extremely ancient one and had probably established a fairly stable facies quite early in the Mesozoic period. Many of the existing species possess characters which are undoubtedly primitive and show the great antiquity of the group.

### 8. The Decapod Crustacea of the Patna State (Orissa).

B. CHOPRA and K. K. TIWARI, Benares.

In the course of a Fish and Fisheries survey, carried out by a party of the Zoologica Survey of India, in the Patna State in March 1946, seven species of Decapod Crustacea were also collected. One species of the genus *Caridina* (family Atyidae) appears to be new, while the remaining six, two of *Paratelphusa* (family Potamonidae), three of *Palaemon* (family Palaemonidae) and one of *Caridina* are already known. A fuller description of *Palaemon dayanus* Henderson, than hitherto available, is given and observations recorded on its range of variation, etc. The form described by Kemp as *Caridina weberi* prox. var. *sumatrensis* from the Inle Lake, in Burma is recorded from India for the first time.

## Insecta

### 9. Preliminary observations on the life-history and bionomics of *Hunterellus hookeri*, the tick parasite in India.

A. BHATTACHARYA, Mukteswar.

In this article a preliminary account of the life-history and bionomics of *H. hookeri* as it occurs in India is given. These were observed to emerge from 24 to 30 days at 27° C. Amongst other signs of parasitism progressive blackening of coxae and rostrum was noted to occur at a much earlier stage. Unlike the observations of other workers the flies are found to emerge mostly during the late hours of the morning. Mating takes place immediately after emergence. The flies are ready to oviposit after 5 to 6 hours and not immediately after mating as has been observed by previous workers. The phototropic nature of *H. hookeri* and its habit of emergence lead to the conclusion that nymphs are parasitized while they are engorging and not when they have taken shelter in places away from light.

### 10. On the male generative organs in *Periplaneta americana* (Linn).

P. D. GUPTA, Lucknow.

The paper incorporates a detailed observation on the morphology of the male reproductive organs of the Cockroach commonly available here. The distinguishing characters of a male and a female cockroach are given in a tabular form.

The testes, which have so far been described to atrophy in an adult cockroach, maintain more or less the same size and remain functional throughout. The structure of the ampullae has been clearly brought out and the relationship with the ejaculatory duct has been described. The definitive ejaculatory duct which has been described by Snodgrass (1936) as *ductus communis* is divided anteriorly into two limbs and each limb communicates independently with the ampulla of the corresponding side. An account of the structure, histology, and the nature of the secretion of the two types of accessory glands : mesadenia consisting of the utriculi breviores and utriculi majores, and ii. ectadenia comprising the phallic glands have also been included. The male genitalia have been described and the inconsistency in the homology of the various components described by the earlier workers has been pointed out.

11. On the role of the blood worm *Chironomus plumosus* in the slow sand filters of the Madras water works.

S. V. GANAPATI, Madras.

Observations on the biotal economy of the blood worm *Chironomus plumosus* are recorded. In burrowing down the filter skin in the slow sand filters of the Madras water works, they are found to rake up the "vital layer" and surcharge the water column above with productive nutrients. While as a direct consequence the "filter skin" is broken and its efficiency impaired, the blood worm larvæ seem to contribute indirectly to a richer culture of micro-biota in the water column.

### Mollusca.

12. Certain observations on the development of the Sacred Chank, *Xancus pyrum* (Linn.).

K. CHIDAMBARAM and M. MUKUNDAN UNNY, West Hill.

The late larval stages of *Xancus pyrum* were obtained from the Ram's Horn and the larval study was continued by rearing the Ram's Horn in the sea-water by protecting it. A short description of the veliger larvae is given in this paper.

### Fishes and Fisheries.

13. On the bionomics and post-larval development of the Orange-chromide *Etiopius maculatus* Bloch.

K. H. ALIKUNHI, Madras.

The early development of the species described by Jones (1937) has been followed up and a complete series of post-larval stages showing the gradual assumption of adult features secured. Two characteristic patterns of pigmentation of the fry are described.

Occurring in large numbers, this small Cichlid yields a minor fishery of some value in various parts of South India. It has a peculiar habit of darting for shelter beneath some object on the slightest apprehension of danger. Based on this habit there is a prevalent method of capture by the deft use of a pair of twigs, between and under which the fish ducks down when frightened.

*E. maculatus* thrives and breeds equally well in brackish as well as fresh water. The food and feeding habits of the species at various stages of its life-history have also been elucidated.

14. On certain cases of fish mortality in the Chetput Fish Farm, Madras.

K. H. ALIKUNHI and S. V. GANAPATI, Madras.

The limnological conditions prevailing before, during and after the occurrence of large-scale mortality of fish in certain ponds in the Chetput Fish Farm, Madras, are discussed in detail.

Unusually low content of dissolved oxygen with complete absence of free carbon-dioxide was characteristic of the waters during the period of distress, which was observed to be at its worst during the very early morning hours of the day. It was interesting to note that at midday the oxygen content in the same ponds was unusually high, on account of the thick blooms of phytoplankton which were present. Analysis of the bottom silt indicated production of sulphuretted hydrogen in appreciable quantities and this appears to be a major factor affecting the fish population of the pond directly or indirectly.

15. Bionomics and development of *Glossogobius giuris* Hamilton.

K. H. ALIKUNHI, G. LAKSHMINARAYAN RAO and P. K. JACOB, Madras.

A systematic study of the natural food of *G. giuris* brought out its marked piscivorous leanings which rarely amount to cannibalism. Extensively distributed both in fresh and brackish waters, this largest of the true gobies grows to over a foot in length, its fair size and abundance adding considerably to the bulk of agreeable food fish for the market. Breeding conditions in fresh water ponds have been elucidated and the development of the species fully worked out. Embryonic differentiation is fairly rapid and the period of incubation lasts two-and-a-half to three days. The delicate hatchling gradually metamorphoses until the ventral fins assume their characteristic adult position when the fry is only about 10 to 12 mm. long.

16. Bionomics, breeding habits and development of the Tench, *Tinca tinca* in the Nilgiri Waters.

K. H. ALIKUNHI and V. RUNGANATHAN, Madras.

The breeding habits and development of the tench, *Tinca tinca*, have been studied. The fish breeds during February—May. Oozing specimens were obtained in March, 1946, stripped and the ova fertilized artificially. The fertilized egg, measuring 1.23 mm. in diameter, is spherical and light amber coloured. Cleavage is partial and regular. Embryo hatches out five-and-a-half days after fertilization. Absorption of yolk is completed by the 25th day when the larva begins feeding. Developmental stages collected from the plankton of the Ooty Lake where the fish abounds, were correlated with the laboratory stages.

A varied assortment of lacustrine faunal constituents was met with in the stomach contents of this fish which is an omnivorous feeder, usually lurking at the bottom in calm and weedy waters. One of the first exotic species ever to be introduced in India, the Tench has not only established itself in the Nilgiri waters but has also adapted itself to the warmer environments of lower elevations as far as the Sunkesula fish farm.

17. The anatomy of *Pseudorhombus arsius* (H.B.).

D. V. BAL and V. B. MARATHE, Bombay.

*Pseudorhombus arsius* belongs to Heterosomata, a group of important food fishes, showing a great diversity of form and structure. This species, common in Bombay waters, has been taken as a type to study the asymmetrical development of parts. The anatomy of this fish has been worked out and the present paper deals with the nervous system.

18. The Tidal Fisheries of the Godavari.

P. I. CHACKO and G. K. KURIYAN, Madras.

The tidal influence of the sea reaches a distance of 35 miles from the river-mouth. Seventy species of marine fishes and crustaceans, which enter the river for spawning, feeding and temporary shelter, contribute to the tidal fishery, estimated to be about 20,000 maunds per year. During the flood season, the following freshwater species descend into the tidal area and contribute to the fishery to a certain extent: *Anguilla bengalensis*, *Silundia sykesii*, *Macrones cavatus*, *M. vittatus*, *Labeo fimbriatus*, *L. calbasu*, *Cirrhitina reba*, *Calla catla*, *Chela untrahi* and *Gobius giurus*.

19. On the culture of *Ophicephalus marulius*, Hamilton, in the Coimbatore and Salem Districts, Madras.

P. I. CHACKO and G. K. KURIYAN, Madras.

Breeding in the deep pools among submerged rocks in the course of the Bhavani and the Cauvery rivers, *Ophicephalus marulius* provide a biseasonal seed supply during March to June and October to December to the ryots of the uplands in the Coimbatore and Salem districts. During these months several cup-like clearings with marulius broods under the vigilance of parental care were observed along the sheltered weedy river margins at a depth of about 4 feet and temperature of 28 to 31°C. The number of fry in a brood is 400 to 600. They are golden yellow in colour; but at the size of 1½ inches develop black pigments along the dorsal and ventral sides. The fry do not swim beyond a distance of two yards from the parents and "nest," and take refuge in the "nest" at the least disturbance of the water. Both the parents take equal share in the care of their offsprings. The ryots in the area collect and stock about 100 fingerlings in each irrigation well and feed them with live minnows and frogs, dead birds and rats, and with kitchen refuse. On account of keen competition for food and cannibalism hardly over 10% of the stock reach maturity. A growth of 1½ feet is reached in the first year. Culture of this species in swampy irrigation tanks and wells has since recently been popularised among the ryots in other districts also. The fingerlings stand transport well, consignments of them having been carried over 400 miles without any mortality.

## 20. Preliminary note on the fisheries of the Tungabhadra (Madras).

P. I. CHACKO and G. K. KURIYAN, Madras.

Catches at the 21 fishing villages bordering the stretch of the Tungabhadra flowing along the western and northern boundaries of the Bellary and Kurnool districts and departmental catches from representative areas have brought out 57 species of fishes. To the list of 40 species already recorded by Bhimachar (1942) and Rahimullah (1943), 17 species have thus been added from the Tungabhadra. The majority of these fishes breed during the floods from July to December. Sixteen departmental collection centres are at work, transporting seed for piscicultural purposes. The comparatively poor annual riverine harvest of 5,000 maunds in the area is largely due to the primitive fishing methods in vogue.

21. Rearing of Gourami, *Osphronemus gorami* (Lacépède) in garden-cisterns and parlour-aquaria.

P. I. CHACKO and R. S. VENKATRAMAN, Madras.

As the people in Java rear Gourami for the table in earthen pots, the fish can also be successfully grown in India in garden-cisterns and parlour-aquaria. Gourami reared in cisterns and aquaria in Madras have been found to feed on the following items: rice cakes, oil-seed cakes, leaves and flowers of garden plants and trees (such as *Hibiscus Rosa-sinensis*, Linn., *Quisqualis indica*, Linn., *Canna indica*, Linn., *Moringa oleifera*, Lamk., and Crotons), vegetables like cabbage and amaranthus; orange and plantain peels, earthworms, spiders, insects (such as flies, ants, crickets, mole-crickets and silver-fishes), centipedes, scorpions, pieces of meat, live fishes (such as *Gambusia affinis*, *Aplocheilichthys blochii*, *Oryzias melastigma*, *Macropodus cupanus*, *Barilius bendelisis*, *Barbus ticto*, *B. stigma*, young *Etioplos suratensis*, and young *Wallagonia attu*). Gourami becomes tame, recognises feeding time, and takes food from the hand of the keeper. As the fish is an air-breather, changing of water in the containers need not be frequently attended to. The rate of growth is satisfactory.

22. Notes on the bionomics of the exotic Mosquito-Fish, *Gambusia affinis* (Baird and Girard) in Madras Waters.

P. I. CHACKO and R. S. VENKATRAMAN, Madras.

Since its first introduction to Madras in 1929, *Gambusia affinis* has established itself in various centres in the province, and with its progressive distribution by the Public Health Fishery authorities, is soon likely to attain a *locus standi*. In the environments of the provincial waters, the fish is found to subsist on small insects (30%), larvæ of mosquitoes and other insects (35%), copepods (10%), desmids and diatoms, such as, *Closterium*, *Cosmarium*, *Pinnularia*, *Synedra* and *Navicula* (20%), algal matter (3%) and miscellaneous stuff (2%). Sexual maturity was reached when three months old. Pregnancy is easily detectable by the puberty spot appearing on either side of the vent. The process of parturition has been closely followed. Post-parturition recuperation is observed to be by consuming about half a dozen of the newborns. The larva grows into a young adult in a fortnight, and commences to feed on mosquito larvæ. The female is more voracious, consuming 260 mosquito larvæ per day, while the male swallows only about 90. The diminution in the population of *Aplocheilichthys blochii* (Jerdon) in and around Madras is traced partly to the predaceous habit of *Gambusia affinis*.

23. On the bionomics of *Osteochilus* (*Osteochilichthys*) *thomassi* (Day).

P. I. CHACKO, R. S. VENKATRAMAN and G. K. KURIYAN, Madras.

*Osteochilus* (*Kantaka*) *brevadorsalis* (Day), *Osteochilus* (*Osteochilichthys*) *thomassi* (Day) and *Osteochilus* (*Osteochilichthys*) *nashi* (Day) occur in the upper reaches of the major rivers in the Madras Presidency. *Osteochilus thomassi* constitutes a fishery in the Tungabhadra river. It is a plankton feeder. Its diet mainly consists of desmids and diatoms, such as *Closterium*, *Cosmarium*, *Fragillaria*, *Gomphonema*, *Melosira*, *Navicula*, *Nitzschia*, *Pinnularia*, *Stauroneis*, *Synedra* and *Surirella*, and rarely of copepods. It attains maturity when 10 to 12 inches in size. The ripe egg is 1.15 mm. in diameter. The breeding season is from June to September. The breeders move upstream, in shoals of about 50,

to shallow shady gravelly banks with a strong current of water to lay eggs. Fingerlings occur in large numbers till December. Experiments conducted have proved that this species is suitable for pond-culture, and that it attains a size of 9 to 12 inches in the first year. The maximum growth is 22 inches. In view of the food situation in the country, during the war and since, it is necessary that hitherto unutilized food-fishes should be made use of. This species is now being used for culture by the rural fishery demonstration units in the presidency.

## 24. Fish and fisheries of the Patna State (Orissa).

B. S. CHAUHAN and K. S. MISRA, Benares.

This paper deals with the results of a Survey of the freshwater Fish and Fisheries of the Patna State (Orissa), conducted by the Zoological Survey of India in March, 1946. The different types of fishes met with in different kinds of habitats in the state have been recorded and their relative abundance at various places noted. A list comprising of 64 species, belonging to 17 families, is given; 33 species belong to the family Cyprinidae, four each to Cobitidae and Bagridae, three each to Siluridae, Ambassidae and Ophicephalidae, two each to Schilbeidae, Sisoridae and Mastacembelidae and one each to Clupeidae, Dorosomidae, Notopteridae, Clariidae, Xenentodontidae, Nandidae, Cobidae and Mugilidae. As far as possible local names have also been appended. The main water resources of the state suitable for fishery development, the local fishing methods prevalent in the state, etc., have been dealt with. The different fishing devices and implements common in the state have been described. An interesting method of night fishing has been noted.

## 25. Preliminary studies on the pancreas of Elasmobranchs of West Coast.

K. CHIDAMBARAM and M. DEVIDAS MENON, West Hill.

The investigation on the pancreas of Elasmobranchs was taken up at West Hill to find out (1) the distribution of the islets of Langerhans in the pancreas of the different species of Elasmobranchs, (2) to study the orientation and amount of islet tissue in the gland, and (3) to find out whether the islet tissue can be separated from zymogenous mass for extraction of the insulin. The study carried on for the last one year revealed that:—

(1) The islets are distributed in the main zymogenous tissue of the gland in several groups.

(2) The main islets lie adjacent to the main blood vessels.

(3) The islets of Langerhans cannot be separated easily from the main gland and so for extraction purposes the whole gland has to be treated and insulin precipitated.

(4) Of the 4 species studied the largest amount of islets of Langerhans was in *Rhinobatus granulatus*, *Trygon bleekeri* and *Chiloscyllium indicum* coming next and lastly *Carcharias laticaudus*.

(5) It is rather easy to treat the pancreas of *Trygon* and *Chiloscyllium* as a large portion of the gland which is lacking in the islets can be removed and the remaining portion treated.

## 26. Preliminary study on the chank marking experiments at Tuticorin.

K. CHIDAMBARAM and M. MUKUNDAN UNNY, West Hill.

The experiments on the chank marking conducted at Tuticorin from 1931 reveal that there is migration of chanks from one bed to another or from one place to another in the same bed. The rate of growth of chanks has been varying in chanks of different sizes and in different beds. The variation in the rate of growth of three groups of beds have been indicated. The work done so far indicate the necessity for a closer and comprehensive study of the hydro-biology of the chank beds in the Gulf of Mannar.

## 27. The caudal skeleton of Orissa carps.

M. PETER DEVASUNDARAM.

The paper deals with the caudal skeletons of certain carps of Orissa. The caudal skeletons have been studied at different developmental stages with a view to use the plan of the skeletons for identification of fingerlings.

28. On a case of surface congregation of carps in isolated rock pools in the stream bed at Mettur Dam.

S. V. GANAPATI, Madras.

Consequent on the stoppage of flow from the Mettur Reservoir during the unusual draught seasons of 1945-46, surface congregations of carps appeared in the isolated rock pools of the stream bed. Observations on their conditions of existence are recorded.

*Cirrhina cirrhosa* and *Labeo koniuis* were the major species in the congregations, the specimens being mostly adults. Except for signs of emaciation no pathological condition was observed on the body, in the mouth or on the gills. The gut was usually empty.

The hydrological conditions were hardly abnormal. A strongly expressed thermal, oxygen, carbonate and bicarbonate stratification was formed at about 2 p.m. and complete circulation effected at about 6 a.m. daily. The surface layers were supersaturated and the bottom layers undersaturated but not fatally deficient in oxygen content. The waters were highly alkaline but low in chloride content.

*Microcystis* and *Spirogyra* were abundant but the typical diatomic food organisms were rare. The largest area for movement happened to be at the surface of these irregular rock pools. Overcrowding, starvation and bottom living predators seem to have driven the congregations to the surface.

29. Notes on the Hydro-biology of carp spawning in the Cauvery.

S. V. GANAPATI, K. H. ALIKUNHI and A. R. K. ZOBEIRI, Madras.

Even in Upper India where definite observations on the spawning of carps are on record, their physical, chemical and biological factors are still unsettled. With a view to study the above problems with reference to the South Indian Carps of the Cauvery observations were started from the commencement of the monsoon in 1946 in the upper reaches of the river. Hydrological data gathered at Hogainakal before and during the spawning period were as follows:—

Date.	Turbidity in cm.	Colour.	Temper- ature. °C	pH.	Diss. O <sub>2</sub>	% sat.	Free CO <sub>2</sub>	Carb. Bicarb. parts per 100,000.	Chlo- ride.
8/7/46	5.5 to 7.7	Muddy	24.5-24.6 (76.1 F)	7.6	5.439- 5.643 cc-1	89.3- 92.8	0.102- 0.122	nil 3.355	0.2
27/8/46	7.5 to 9.0	Muddy	23.5- 23.6 (74.3 F)	7.5-7.8	5.225- 6.094 cc/1	84.5- 98.4	0.091- 0.122	nil 2.745- 3.202	0.2

Catches on 8/7/46 showed *Labeo koniuis*, *Cirrhina cirrhosa* and *Calla calla* to be in roe. Eggs were obtained on the 22nd July and subsequent days. They were mainly of *L. koniuis* as revealed by subsequent developmental studies. A few catfish eggs were also obtained. The time of collection, velocity of flow and the embryonic differentiation in the eggs indicated that the spawning might have occurred at midnight about 25 or 30 miles above the Hogainakal falls. The location of the carp fry grounds in the Cauvery, which is of significance with reference to fish seed resources of this Province, and the development of *L. koniuis* are detailed elsewhere.

0. On the nature and evolution of ctenoid scales of fishes.

D. N. GANGULY and S. MOOKERJEE, Calcutta.

The developmental stages of the esturine fish, *Sciaena coitor*, provided all the necessary stages of the scales from the simplest primary structure to the fully formed ctenoid scale. The other fishes studied are *Hilsa ilisha*, *Labeo calbasu*, *L. rohita*, *Calla catla*,

*Boleophthalmus viridis*, *Glossogobius giuris*, *Anabas testudineus*, *Lates calcalifer* and *Mugil parsia*. Our observations support the view that ctenoid scale is an advance over the cycloid scale and that the former is evolved from the latter. Once evolved the ctenoid scale never reverts to cycloid condition. Interesting observations are made on the nature of spines and their correlation with the flexion of the body.

### 31. On the biology of the Pearl-spot *Etrophus suratensis* (Bloch).

T. J. JOB, K. H. ALIKUNHI and N. V. CHOODAMANI, Madras.

Systematic diet analysis of *E. suratensis* from diverse environments of fresh and brackish waters has revealed a higher planktonic feed in the latter. Size-weight comparison of specimens from these two environments, however, revealed no marked difference.

Yearlings of six to seven inches are found to reach sexual maturity. The breeding maxima occur during and immediately after the rainy months. The life story has been completed with full details of breeding conditions in fresh water. Size records of early age groups have been made so as to facilitate determination of seed size in stocking and elucidation of growth rate.

### 32. On the breeding grounds of *Catla* and other major carps in the South Indian Rivers.

T. J. JOB and P. I. CHACKO, Madras.

To meet the growing demand of fish seed for aquiculture, the major river systems in the Madras Presidency were explored with a view to discover the breeding grounds of *Catla* and other major carps. A correlation of the field data gathered by the authors and the Assistant Inspectors of River Surveys in the Godavari, the Krishna, the Tungabhadra and the Cauvery during the past four years has revealed 22 breeding grounds and 94 fluviatile nursery areas. Eggs of *Catla catla* and *Labeo fimbriatus* have been collected from the Godavari, the Krishna and the Tungabhadra, while those of *Labeo kontius* and *Barbus* spp. were procured from the Cauvery and its main tributary, the Bhavani. Complete developmental stages of the first two species have been obtained. The large-scale collection of the seed of these and other major food fishes, including *Wal-lagonia attu*, *Macrones seenghala*, *Barbus tor*, *B. sarana*, *B. hexagonolepis*, *B. carnaticus*, *Cirrhina reba*, *C. fulungee* and *Osteochilus thomassi*, has been initiated, and with local improvised nurseries and transport arrangements the distribution of these valuable seeds is effected for stocking the cultivable waters in different areas.

### 33. Rearing of saltwater fish in freshwaters.

T. J. JOB and P. I. CHACKO, Madras.

The significance of saltwater fish in augmenting the bulk and variety of inland fisheries is brought out. Acclimatisation possibilities of the Pearl-spot (*Etrophus suratensis*), the Mulletts (*Mugil* spp.), the Milk-fish (*Chanos chanos*), the Bekt (*Lates calcalifer*), the Ox-eye Herring (*Megalops cyprinoides*), the Indian Salmon (*Polynemus tetradactylus*) and the Rock-Perch (*Lutjanus argentimaculatus*) in commercial aquiculture are detailed with stocking statistics of the Madras Government Fisheries for the last five years. Experimental data on the technique of conditioning, acclimatisation and transport of the seed as worked out at the Madras Freshwater Biological Station and at the Marine Biological Stations at Krusadai and West Hill, are given. Fifteen extensive seed grounds of *Etrophus suratensis* have been located in the creeks and backwaters of the coastal districts. The salient points of food, rate of growth, spawning habits and bionomics of these species of piscicultural value are noted. It is indicated that the progressive exploitation of the seed resources of these acclimatisable saltwater species would greatly facilitate profitable pisciculture in the brackish and fresh inland waters of this country.

### 34. Hydrological aspects of the spawning of the major Indian carps in the *Bundhs* of Bengal.

T. J. JOB and S. V. GANAPATI, Madras.

Conflicting views have been advanced on the factors influencing the spawning of the Indian carps, and these may broadly be classified as biological, chemical, physical and meteorological. Considerable work on these aspects has yet to be done in order to elucidate

this vital problem of fish seed resource. Data collected during a season's investigations on six *bundh* type of ponds in Bengal are recorded. Detailed studies of the hydrological conditions in one of these ponds made prior to, during and after an intensive flooding of the pond throw much light on the several conflicting views expressed so far, and thus help materially for a better approach to the problem.

### 35. Observations on the spawning of carp in a tank in the Punjab.

HAMID KHAN, Lahore.

Observations on the spawning of carp, namely, Rohu (*Labeo rohita*) and Mirgal (*Cirrhina mrigala*), have been recorded from Batala Fish Farm in the Punjab. This farm is an interesting artificial reservoir in which water containing an excess of carbon dioxide is pumped into a large tank of Moghul's period.

The fish spawned for the first time in 1946 since their introduction in the tank in 1939. Their behaviour indicated that as long as they remained confined in the tank, the flood water caused by the heavy local rains, that entered the tank, had no effect on the fish, but as soon as the fish had an access to the flood in the inundated fields, they indulged in sexual play there and laid their eggs. Apparently the "sexual play" in the inundated fields was responsible to a large extent for the ovulation.

### 36. A note on the destruction of carp fry by larvæ of aquatic insects.

HAMID KHAN and AMJAD HUSAIN, Lahore.

Destruction of carp fry by beetle larvæ has been observed at Chhenawan Fish Farm. All the nurseries stocked with eggs showed red-tailed Crustacea and beetle larvæ. Nurseries not stocked with eggs did not show any such larvæ and if so in negligible quantities. The beetle larvæ were, therefore, collected along with the eggs from the spawning grounds. The presence of the beetle larvæ found in nurseries was to a great extent proportional to the strength of the eggs stocked. The percentage of the fauna collected on 16-7-1946, i.e., 12 days after the eggs have been put, was *Carp fry* 25%, *Crustacea* 30%, *Beetle larvæ* 15% and *Miscellaneous fry* 30%. Heavy mortality of fry in the nurseries was entirely due to the presence of beetle larvæ which as experiment showed could kill the fry at the rate of 11 by one larva per hour.

### 37. Further observations on the spawning of carp in ponds at Chhenawan Fish Farm in the Punjab.

HAMID KHAN and AMJAD HUSAIN, Lahore.

The fish spawned in closed water at Chhenawan Farm after receiving a heavy shower that flooded the ponds. The fish began to play 12 hours after receiving the first flood water. Play of breeders lasted for about 2 hours. Spawning process took about 2 hours.

The breeders weighed not more than 2 seers although there were fish weighing up to 8 seers in the pond. But the big fish did not spawn, probably the flood was insufficient to stimulate them and they remained egg bound. It is an important discovery specially for the owners of ponds similar to the wet and dry *bundhs* of Bengal. If the owners desire that their fish should spawn annually even with mild flood they should introduce predominantly a large number of young breeders weighing not more than 4 or 5 lbs.

Eggs were seen over the grassy banks. There were no clouds at the time of spawning. The temperature of water at which spawning took place ranged from 90°F. to 95°F.

### 38. Investigation on the spawning of *Catla catla* (Hamilton) in the Punjab.

HAMID KHAN and UDE SINGH RAI, Lahore.

Due to the restricted distribution of *Catla* in the rivers and streams of the Punjab, its spawning has not so far been studied. The presence of *Catla* fry in large numbers in the backwaters of the rivers is an indication of the spawning of *Catla* in those places. *Catla* is not known to breed in confined waters.

*Catla* fry formed 60% of the fish population of a backwater of River Sutlej known as Khakhra Dhand. It is not found anywhere else in such a great number as in the Punjab. Adult *Catla* is not present in this dhand before the spawning season. The spawning of *Catla* in this place is independent of the local rains. It takes place during the month of



June or July. The fields lying in between the river and the dhand are inundated when the level of Sutlej River rises due to the melting of snow and rains in the hills. *Catla* present in the river are most probably attracted by the saline water of the dhand and during their journey from the river to the dhand they spawn in the inundated fields. The spent-up *Catla* leave the dhand when the water from the dhand and the inundated fields recedes.

### 39. Effect of weirs on the distribution of *Catla catla* (Hamilton) in the Punjab.

HAMID KHAN and UDE SING RAI, Lahore.

There are in the Punjab five big rivers, namely, Sutlej, Beas, Ravi, Chenab and Jhelum, with Jamna and Indus forming the southern and northern boundaries of the Province. With the exception of River Beas all other rivers have weirs, numbering 14 in all, which divert most of the water from the river into the canals. Due to the construction of these weirs, large stretches of the river beds remain dry or have very little water during the major part of the year.

*Catla catla*, which was at one time found throughout the plains of the Punjab, is now found in restricted areas as its movements are interfered with by the weirs. Due perhaps to its big size and shy habits *Catla* does not seem to make use of fish ladders.

### 40. Study of the factors which affect the growth of *Catla catla* (Hamilton) and causes of their mortality during summer months in Khakhra Dhand in the Punjab.

HAMID KHAN and UDE SINGH RAI, Lahore.

Khakhra Dhand is situated in old bed of River Beas, 15 miles on the east of Ferozepore weir. It contains *Catla* fry in great abundance. *Catla* spawn in the fields between the dhand and River Sutlej which lies on its south. The growth of *Catla* fry in this dhand is rapid as compared with their growth in other waters. During April, most of the fish die in this dhand.

The quantity of "Kallar" Salts increased (127.92 to 170.25 parts per 100,000 parts of water) during April, 1946, in this dhand. The excess of salts proved injurious to the plants which putrified due to the rise of the temperature of the dhand water, utilising all the oxygen present in it. This proved fatal to the fishes living in the dhand.

The "Kallar" Salts, in moderate quantity (40 to 80 parts in 100,000 parts) in the dhand water, seem to supply the elements necessary for the luxuriant growth of phytoplankton and other aquatic plants, which are food of *Catla*.

### 41. On the quantitative analysis of the food of the climbing perch, *Anabas testudineus*.

H. K. MOOKERJEE, D. N. GANGULY and H. K. DE, Calcutta.

Interesting data have been collected after examining the stomach contents of 107 specimens of the fish at various stages of development from different localities.

### 42. On the qualitative and quantitative analysis of the food of *Ophicephalus stewartii*.

H. K. MOOKERJEE, D. N. GANGULY and S. P. SARKER, Calcutta.

Interesting data have been collected after examining the stomach contents of 100 specimens of the fish, varying from 10 mm. to 188 mm.

### 43. Disposition of the pyloric caeca in a marine fish, *Serranus pantherinus*.

M. RAHIMULLAH, Hyderabad Deccan.

The pyloric caeca of this fish have been worked out. There are two bunches of caeca, situated on the ventral side of the stomach; each bunch opens by a separate duct. The structure and nature of the caeca in this fish have been compared with others of the family Serranidae to which this fish belongs and it has been shown that the nature of caeca, although helpful to some extent, cannot be regarded as a specific character.

It has also been suggested that it would be a very good problem if a comparative study of the structure of the teeth is made and it is correlated with the food and the histological structure of the stomach in different fishes.

## 44. Fisheries problems concerning Manjra River.

M. RAHIMULLAH, Hyderabad Deccan.

During the survey of the River Manjra it has been found that *Cailla*, which is indigenous to the Hyderabad State, is mostly confined between the Ghanpur anicut and the Nizamsagar reservoir, and is not found either above or below this portion of the river. Similarly, the prawns which were quite plentiful in many parts of the river have disappeared from them after the construction of the Nizamsagar reservoir. The author has been unable to explain these observations.

## Amphibia.

45. Polymely in the common Indian bull frog, *Rana tigrina*.

THAKUR S. B. SINGH, Nagpur.

The paper makes an attempt to record another instance of a case of polymely in the common Indian bull frog, *Rana tigrina*. Mahendra (1936) described one such case in detail from a female frog which had a polymelous limb laterally on the right side. The present case is also from a female frog which has enabled me to fill the gaps in our knowledge of the vascular supply of the extra fore-limb. The supernumerary fore-limb arises ventrally on the right side of the pectoral girdle and is covered at its base by a thin fold of skin. It has a forearm only with four digits. A small vein drains the impure blood to the right mandibular vein of the external jugular, and a branch from the right subclavian artery supplies the arterial blood. The musculature and bones on the inside have the same compliments as are present in a normal fore-limb without the brachium. Its junction with the right clavicle was close to the latter's union with the right scapula. A small nerve from the main right brachial innervated the extra limb. A reference is made to grafting experiments and organiser in amphibian embryos.

## Reptilia.

46. The circulatory system of *Hydrophis cœrulescens* (Shaw, 1802).

D. V. BAL and K. V. NAWATHE, Bombay.

The circulatory system of *Hydrophis cœrulescens*—a sea snake—has been described in detail in this paper. The heart of this snake is elongate and is characterized by having the right auricle nearly double that of the left. It has been found that the number and distribution of blood vessels of the urinogenital organs differs in the two sexes.

47. The vocal organs of *Hemidactylus flaviviridis* Rüppel.

BENI CHARAN MAHENDRA, Pilani.

The author has made a minute study of the vocal organs of the house-gecko. The more important features discovered are as follows:—

(1) The *cricoid* of *Hemidactylus flaviviridis* differs from that of *H. garnoti* in the structure of its component rings, the absence of the processus anterior inferior and anterior superior, and the presence of a pair of dorsal longitudinal connecting cartilages.

(2) The number of tracheal rings varies from 45 to 51, and of bronchial ones from 6 to 8. Most of the former are closed. The latter are incomplete towards their inner sides and are connected to each other to form an irregular network.

(3) There is no dilatation of the trachea.

(4) The hyoid apparatus is characterized by the development of a blunt lateral limb on the *cornu hyale*, the absence of connection between the *cornu hyale* and *cornu branchiale I* and the dorsal region of the paroccipital process, and the presence of a vestigial *cornu branchiale II*.

(5) The larynx possesses two pairs of muscles (*M. compressor laryngis* and *M. dilatator laryngis*), which are innervated by the *Nervus laryngeus superior* and *N. laryngeus inferior*.

(6) The vocal cords are present. When fully extended, they virtually separate a dorsal chamber from a ventral one inside the larynx.

48. The Pigmentary response in *Hemidactylus flaviviridis* Rüppel.

BENI CHARAN MAHENDRA, Pilani.

The present study on *Hemidactylus* extends our knowledge of reptilian pigmentary response to a family of lizards not hitherto investigated properly. The extreme paucity of chromatophores in the integument makes the investigation all the more valuable, since the behaviour of melanophores is not masked or affected by the presence of coloured corpuscles. The response to high and low temperatures, light and darkness, black and white background, and emotions has been studied, and the various theories explaining the control and co-ordination of melanophore activity have been discussed.

49. The Nervous System of *Hemidactylus flaviviridis* Rüppel.

BENI CHARAN MAHENDRA, Pilani.

The brain, which has been described in detail, is typically lacertilian in its form and structure. The spinal cord shows the brachial and lumbo-sacral enlargements and extends in a much attenuated form in the tail. It has a sulcus longitudinal superior and a sulcus longitudinal inferior. There are twelve cranial nerves which have been described minutely. The first and second pairs of spinal nerves arise by ventral roots; the others both by dorsal and ventral ones. The sixth, seventh, eighth and ninth spinal nerves from the brachial plexus; and the first, second and third presacral nerves, together with the intersacral, the sciatic plexus.

## 50. Some new lymph-glands in the serpents.

MAHESHWAR SINGH SOOD, Pilani.

The author has discovered a number of new lymph-glands, situated inside the neural space of the vertebral column in *Typhlops braminus*, *Eryx johni*, *Ptyas mucosus*, *Lycodon aulicus* and *Enhydrina schistosa*. These glands have the typical lymphoid structure with the mass of lymphocytes compactly aggregated together. They occur in a remarkably regular manner in one and the same species, although the several species investigated by the author differ from each other to some extent. The most constant of these glands are a pair of ovoid, elliptical, or rounded ones underneath the spinal cord. A large lymph-gland occurs also above the spinal cord in *Lycodon aulicus*.

## 51. The intra-neural arterial supply in the serpents.

MAHESHWAR SINGH SOOD, Pilani.

Although a number of investigators (Beddard 1904, 1906; Thompson 1914; Ray 1934, 1936, etc.) have dealt with the disposition of the anterior vertebral artery, intercostal arteries and tributaries of the azygos vein in several species of snakes, there is a remarkable paucity of information about the arrangement of the blood vessels inside the neural cavity. The author attempts to fill up this gap by describing the distribution of the intra-neural arteries. Each intercostal artery enters the inter-vertebral foramen antero-ventrad to the conjoined stem of the dorsal and ventral nerve-roots. Immediately after its entry, the artery runs transversely inwards along the ventral aspect of the spinal cord. It meets its fellow of the other side in the mid-longitudinal line underneath the median fissure of the spinal cord to form a longitudinal vessel, the ventral spinal artery (*Arteria spinalis inferior* of Dendy or *Tractus spinalis ventrales* of Hoffmann). This latter gives rise in each inter-vertebral plane to a vertical arteriole that passes upwards in the central median fissure and may be called the segmental spinal artery. At the bottom of the fissure the segmental spinal artery divides into two branches, supplying the two halves of the spinal cord and forming a capillary-plexus there.

52. The presence of a *Sinus Pulmonalis* in the heart of *Rana tigrina*.

HIRA LAL SHARMA, Pilani.

A scrutiny of serial transverse and sagittal sections of the heart of the bull-frog, *Rana tigrina* Daud. establishes the presence of a short chamber hitherto undescribed—the *sinus pulmonalis*, which is analogous to the *sinus venosus* and conveys the blood of the pulmonary veins into the left auricle. It is a dorso-ventrally compressed sac produced downwards in the form of a funnel, the latter opening into the auricle by a vertical tubular portion. The wall of this sinus resembles that of the *sinus venosus* in its thickness and histological structure, but its muscular fibres are directed in a different direction. Valves occur both at the place where the pulmonary veins open into the *sinus pulmonalis* and at the site of the latter's opening into the auricle.

**Mammalia.**

53. Notes on two whales stranded in Baroda State, Orca at Aramda in 1943 and Balaena at Gajana in 1944.

S. T. MOSES, Baroda.

A Killer Whale, 23 feet 8 inches long, was stranded in Aramda, near Port Okha, in Kathiawar in March 1943 and a Right Whale, 71 feet 2 inches long, at Gajana, near Dabka, in Baroda District in November 1944. The external features, internal anatomy and osteology, skull, vertebral column, sternum and ribs of the Killer Whale are described as also the external features, anatomy and osteology of the Right Whale. The systematic position of the two rare whales never seen in our waters is discussed, the Aramda Whale being identified as *Orca gladiator* (*Orcinus orca*) and the Right Whale as *Balaena* apparently of the species *australis*.

**Embryology.**

54. The early stages of the development and the structure of the placenta of the Bat (*Pteropus giganteus giganteus* Brünnich).

M. A. MOGHE, Nagpur.

While various aspects of the embryology of many species of microchiroptera have received attention at the hands of various workers (van Beneden, van Der Stricht, Duval, Branca, Nolf, Kohlbrugge, Da Costa, Wislocki, Gerard, Ramaswami, Wimsatt and others), our knowledge of the embryology of megachiroptera is limited chiefly to two papers by Selenka and Goehre. The author of this paper collected pregnant uteri of the large fruit-bat during 1940-1943. He examined several stages of development from the early blastocyst to the early placenta. These stages show (1) the structure of the uterus just before pregnancy; (2) the formation of the implantation cavity and the early and late morula; (3) the first attachment of the blastocyst and its differentiation into embryonic mass and the trophoblast (the attachment is at first lateral and later mesometrial); (4) the bilaminar blastocyst; (5) the appearance of a cavity in the blastocyst; (6) the appearance of shield ectoderm and entoderm; (7) the appearance of medullary folds; (8) the formation of the myotome, nephrotome and somatic and splanchnic mesoderm; (9) the formation of the allantois and (10) the early placenta. The question of the origin of the amniotic cavity and the nature of the placenta are discussed.

**Genetics.**

55. Inheritance of Syndactylism in Haryana Cattle.

S. SINGH and P. BHATTACHARYA, Izatnagar.

In Bovine, the hoof is bifurcated with wider solar surface at the bottom than that at the top of the hoof. Nine calves were born at the Madhuri Kund Farm at Muttra, U.P., between 1937-41, which displayed a peculiar shape of the hoof. The hoof was unbifurcated and it did not compare strictly with that of equine as it tapered down in the form of an inverted cone. Thus the ground surface of the hoof was comparatively very narrow. In some of the calves the condition was unilateral and in others bilateral.

This is an undesirable character as the animals possessing such hoofs walk with a limping gait and become unfit for draught purpose. Study of the pedigree records of the affected animals reveals that the character is an autosomal recessive one and most probably monofactorial in nature.

**Hydrology.**

56. Hydrology of a typical microbiotal water in Madras.

S. V. GANAPATI, Madras.

The seasonal changes in the ecological conditions of a type of pond in Madras equally rich in phyto and zooplankton are described. The important features of the pond are its greenish hue, high turbidity and moderate temperature. Dissolved oxygen, free carbon-dioxide, nitrous and nitric nitrogen were absent. Hardness, solids, chlorides, organic matter, phosphates, ammonias, silicates and pH were high.

The microbiota consisted of 11 species of phytoplankton and 13 species of zooplankton. They were characterised by the absence of diatoms, desmids and protozoans and by the abundance of eugleninae, blue greens, rotifers and copepods.

The inter-relationship that existed among the physical, chemical and biological conditions of the pond during the four seasons of a year is also discussed in detail.

### 57. Studies on the Chemistry and Physics of the waters of a fish tank and Gomti River, in Lucknow City.

M. P. UPADHYAYA, Lucknow.

Physical and chemical characteristics of water constitute an important environmental factor for fish. Fisheries investigations, therefore, involve determination of the hydrographical and meteorological changes affecting rivers and tanks. Physical and chemical changes in the waters of the La Martinere College tank and the Gomti River, Lucknow, have been described in this paper.

The La Martinere College tank measures 1,800'×315'×10' and holds a large stock of edible fish. The Gomti River is a perennial tributary of the Ganges holding a fair number of fishes.

*Sampling of water.*—The samples were collected from the same place in a bottle, one foot below the surface, by a man wading to a depth of 4 feet from the bank.

Information has been acquired concerning the colour, temperature of water, dissolved oxygen and carbon-dioxide, hydrogen ion-concentration, total solids, total hardness, chlorides, ammoniacal nitrogen, albuminoid nitrogen, nitrites and nitrates.

### General.

### 58. Survey of the Marine Fauna of Karwar.

P. W. GIDEON, J. P. JOSHUA, H. V. KASHYAP, A. M. PATIL

and A. R. SHESHADRI, Dharwar.

The scientific study of the Fauna of Krusadai Islands and the valuable material afforded to Educational Institutions at the Krusadai Research station by the Madras Fisheries Department, has prompted a desire to afford similar facilities in Coastal areas of the Bombay Karnatak.

Karwar being about 100 miles from Dharwar, the Zoology staffs of the Karnatak College and the Madras Christian College undertook a survey of the Marine Fauna of Karwar in December 1945 and May 1946.

The paper deals with the Fauna found in different parts of the coast and neighbouring islands. The programme of work and the technique were similar to those adopted at the Krusadai Research station. An attempt is being made to correlate the presence of the various animals at different seasons with the environmental conditions and the type of plankton found at the time.

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## SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY.

PRESIDENT : DR. I. KARVE.

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### 1. Archaeological evidence of Chinese contact with Cranganore (Cochin State—South India) in the middle ages.

ANUJAN ACHAN, Trichur.

1. Though the cultural contact of China with India had terminated according to the Chinese Chroniclers, by the middle of the Sung Period (1036 A.D.), the commercial relations between Southern India and China continued for two or three centuries more. The discovery of a hoard of Chinese copper coins from the Tanjore District, forming an unbroken series of the entire Sung period from 1008—1253 A.D., is an indication of the continued contact of China with the South of India during the middle ages. (*Sino-Indian Studies*, Vol. I, October, 1946).

2. In the recent excavations at Arikamedu near Pondicherry by the Archaeological Survey Department of the Government of India, fourteen sherds of the Chinese celadon ware have been picked up, which are said to have all the characteristics of the Sung wares meant for export trade, ascribed to *circa* tenth-twelfth centuries A.D. (*Ancient India*, No. 2, July, 1946).

3. The experimental diggings conducted by the Government of Cochin at Cranganore near the Periyar basin during the summer of 1946, have revealed the existence of a number of Chinese sherds along with local potteries, some of which are plain while a few are decorated. As the decorated wares are later in date than the plain ones, the celadon sherds picked up from Cranganore may be assigned to the thirteenth-fourteenth centuries A.D.

4. "The export trade in celadon became brisk in the Sung period (A.D. 960-1279) and reached its peak under the Yuan dynasty (A.D. 1280-1368)." Plates of this ware are said to have been found extensively in Asia and East Africa. In Southern India, besides Cranganore, it has been found in Arikamedu and on the banks of the Tamraparni in the Tinnevely District.

5. The archaeological evidence of the Chinese contact with Cranganore and the west coast has been further supported by historical notices. Chau Ju-kua, a Chinese traveller, referring to the Chinese and Arab trade in the twelfth and thirteenth centuries in his book *Chu-fan-che*, mentions a kingdom in the extreme south-west called "Nan-pi," which is identified with Malabar as the land of the Nairs or the Nam-puries. Its capital is styled as Mie-a-mo or Ma-li-mo (?), and among the goods exchanged are mentioned: Ho-chi silks, porcelain ware, camphor, cloves, sandal-wood, cardamoms and gharu-wood. Kulin (or Quilon) is said to be at a distance of five days' journey with the monsoon from Nan-pi. (*Friedrich Hirth—St. Petersburg—pp. 87-89*). Ma Huan, another Chinese traveller, has referred to the trade between China and the West Coast in the later fourteenth century. (*History of Kerala—Menon—Vol. I., p. 163*).

6. Sherds of China were picked up from Cranganore occurred invariably in mixed deposits between the second and the fourth layers. Along with them were also found red potteries of the local variety with decorations very much similar to those met with at Arikamedu, near Pondicherry, in the recent excavations.

### 2. Microburin-like and snakehood-like artefacts from Langhnaj (N. Gujarat).

H. D. SANKALIA and A. C. SEKHAR, Poona.

A few microburin-like artefacts from the Langhnaj (N. Gujarat) Excavations are discussed in this paper, in the light of the usual definitions of a burin facet, and it is shown that some of them at least can be regarded as micro burins. Also a new (?) type of artefact resembling the hood of a serpent is discussed, and the possibility is suggested that the makers of this artefact might have had a hood-like shape in view.

## 3. Age of rock-cut caves in Cochin.

Y. D. SHARMA, Madras.

This paper correlates some of the rock-cut caves in Cochin State, recently surveyed by the Archaeological Survey of India, with similar caves situated elsewhere in South India, and attempts a sequential dating of them on the basis of pottery finds and architectural technique.

The caves in question are not, as has sometimes been advocated, Vedic, either culturally or chronologically; neither are they likely to be Buddhist. They are doubtless prehistoric, and must be taken as related to the megalithic culture of Kerala.

## 4. Prehistoric Cochin.

V. D. KRISHNASWAMI, Madras.

In this paper are given the results of a recent survey of megalithic monuments carried on by the author in the Cochin State on behalf of the Archaeological Survey of India, in collaboration with the State Archaeological Department. After classifying these monuments into definite types, a typological sequence is made from these. Two new types of monuments, hitherto unrecognised have been brought to light. The relationship of the several monuments is indicated by a study of the pottery and other objects emanating from them, which are now stored in the State Museum.

While the sources of dating these monuments are rather meagre, future lines of work are indicated in the paper to unravel the many problems connected with these monuments, which are characteristic of the entire Kerala Region. Incidentally the discovery of a Stone Age in Cochin during the course of the present exploration is also dealt with, revolutionising the old idea that there was no Stone Age at all in Kerala.

## 5. On the relation between the occurrence of the number of whorls and the head-form.

P. C. BISWAS, Calcutta.

The purpose of the study is to find out whether there is any racial difference in the occurrence of whorl (of hair on head) and also to trace if there is any relation between the occurrence of the number of whorls and the head-form.

From the data the author has found out that the double whorls occur always on the broad head. As regards the racial difference the author has got a clear difference in the occurrence of single and double whorls among the Indians, the Germans and the Chinese. Single whorl occurs among the Indians and the Germans in 93% and in 64% among the Chinese. The double whorls appear among the Indians and the Germans in 7% and among the Chinese they occur in 36%.

## 6. Racial affinities of the Kols of Central Provinces of India.

B. K. CHATTERJEE, Calcutta.

The analysis of the somatometric data of the Kols reveals the following basic aboriginal characters of the majority of the primitive tribes of India.

Stature is short and the body is slightly built. Dolichocephalic form of head, skin colour chocolate brown, facial form squarish and the height is short, forehead flatish, steep or slightly sloping and projecting. Supraorbital part of the frontal bone straight and arcnoided and supraorbital ridges are slightly marked, eyes are narrow in slit and oblique, the colour of the eyes is of dark brown. The root of the nose is remarkably depressed and the nasal skeleton is broad at the middle and the nasal form is platyrrhinic except when mixed with the higher types and the nasal profile is concave. The upper and lower lips are thick and the chin is either negative or neutral.

Head hair is generally straight by the presence of the slightly cynotrichous form of hair and the colour of the hair is of dark brown, the presence of body hair is scanty. Characteristic of this type is the narrowness of the forehead relative to the broadness of the head and the cheekbone which give the face a peculiar appearance making the type recognisable in mixture with higher races.



## 7. The Gadabas of Koraput District : A note on their origin and death-rites.

A. M. SOMASUNDARAM, Masulipatam.

The Gadabas are an aboriginal tribe, now inhabiting Koraput District of Orissa, and states like Bastar and Kalhandi. Scholars are of opinion that they had migrated to their present habitat from the banks of the river Godavari and it is thought that the term "Gadaba" is derived from the name Godavari. They are classified as belonging to the Munda Ethnic Stock, and possess physical features of Proto-Australoid type.

The Gadaba religion consists of worship of animals, deities, and ancestral spirits. The tribe is divided into sects and gothras, each of the latter having a totemed name. Death rites among them are simple but the Gottar ceremony, the most important religious function, involves huge expenditure. It means the worship of ancestral spirits. On the occasion large number of he-buffaloes are most barbarously slaughtered. The only parallel to this inhuman activity is found in the Gaur Ceremony of the Sauras. It is much regretted that the Government has not taken proper steps to put a check to this practice. Anthropologists therefore should strive for the eradication of this evil among this small forest tribe.

## 8. Serological survey of the United Provinces (1941).

D. N. MAJUMDAR, Lucknow.

Under the auspices of the 1941 Census operations an anthropometric and serological survey of the people of United Provinces was carried out by D. N. Majumdar. The anthropometric data were analysed by Professors P. C. Mahalanobis and C. R. Rao, and the results were submitted in a joint paper by Mahalanobis, Majumdar and Rao to the Anthropology Section of the *Indian Science Congress Session* at Bangalore in 1946. The present paper deals with the serological survey; the statistical analysis of the data was done by Kunwar Kishen, Statistician to the Agricultural Department, U. P. The serological evidence is found to corroborate the findings of the anthropometric survey. With regard to the racial status of the various tribes and castes of the U. P. 4,000 bloods were tested belonging to 22 social groups.

## 9. Serological survey of cultural Gujarat (1946).

D. N. MAJUMDAR, Lucknow.

Along with the anthropometric survey of cultural Gujarat, 3,000 blood group tests were made and the data statistically analysed. A comparative study of the gene frequencies in different tribes and castes has been made and the results appear to be significant from the racial point of view.

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## SECTION OF MEDICAL AND VETERINARY SCIENCES.

PRESIDENT : PROF. G. PANJA, M.B., D.Bact. (Lond.), F.N.I.

### Medicine and Public Health

1. The incidence of anthrax in man in the Madras Presidency and suggestion of its preventive measures.

G. R. VISWANATHAN, Madras.

In fourteen villages, the incidence of anthrax is recorded in 72 persons who are all non-vegetarians (70% adult males and 30% females) of which 27 died. The source of infection is traced to handling, skinning and eating of carcasses of cattle, sheep and goats that died of anthrax. In the majority of the cases, the main lesion was the malignant pustule, associated with painful enlargement of glands in the axilla and after death oozing of fluid blood from the nose as in animals. The treatment consisted in the use of sulphur drugs, neosalvarsan and anti-anthrax serum.

Preventive measures such as proper disposal of the carcasses, early detection and treatment of cases, disinfection of premises, use of anti-anthrax serum and spore vaccination of animals are suggested.

2. Intestinal fluxes at the hill station of Darjeeling.

G. PANJA, Calcutta.

(Inquiry in hill diarrhoea, Indian Research Fund Association).

An investigation into the causes of bowel disorders at Darjeeling during the monsoon period was carried out under a grant from the Indian Research Fund Association. Typical hill diarrhoea was not met with. Outsiders as well as local residents were found affected. 213 samples of stool from 185 cases were examined for helminthic ova, protozoa and intestinal pathogens by cultural methods on four sets of media—S S agar (Difco), D. E. C. medium (Panja & Ghosh), Desoxycholate citrate agar (Leifson) and MacConkey's bile salt agar. Histolytica infection was found in 8 samples, giardia in 15, heterophyes fluke in 2 and in the remaining 188 belonging to 160 cases, *Bact. shigae* in 5, *flexneri* in 18, *sonnei* in 3, New Castle bacillus in 3, paracolon bacillus in 33 and no pathogens in 85. *Bact. asiaticum*, *carolinus*, *morgani* etc., were isolated from the rest of the samples. Hookworm and ascaris infection were commonly found.

It is interesting to note that some motile paracolon organisms producing acid and gas in sugar media showed antigenic relationship with Schmitz's bacillus. Such organisms were found toxic to rabbits and agglutinins against such organisms were also found in the blood of affected persons but no agglutinins for the dysentery bacilli. Pathogenicity of *Bact. asiaticum* isolated could not be established by sero-agglutination and animal inoculation tests.

Another very interesting point is that in a large number of cases with symptoms of copious diarrhoea, no intestinal pathogens could be isolated inspite of the use of the above four media. On examination of diarrhoeic stools of such cases, enzymes, such as amylase and trypsinase were found deficient. Such a deficiency is considered to be due to altered physical conditions such as temperature, humidity and atmospheric pressure and may be a factor in the causation of indigestion and diarrhoea. In normal stools such a deficiency was not found. In the plains, such a deficiency was also found in diarrhoeic stools but to a much less degree, although normal stools exhibited practically the same deficiency as in the hills. The figures given below illustrate the findings.

Stools.		In Calcutta.	At Darjeeling.
Normal	{ Amylase	25 to 100 units	20 to 100 units
	{ Trypsinase	50 to 200 "	50 to 140 "
Diarrhoeic	{ Amylase	7 to 50 "	0.6 to 10 "
	{ Trypsinase	25 to 100 "	2 to 20 "

Water used at Darjeeling for drinking and domestic purposes was tested for the presence of chlorine and the test was positive. Chemical examination showed total solids within normal limits i.e., 8.421 only per 100,000; nitrates, sulphates and iron being absent.

Persons with a history of bowel complaints in the plains were found more susceptible to intestinal disorders when arrived in the hills.

Paracolon organisms antigenically related to Salmonella organisms and Schmitz's bacillus were also isolated from cases in Calcutta. A motile lactose non-fermenter producing acid only in sugars was isolated and found antigenically related to Schmitz's bacillus and the patient's blood showed agglutinin to a titre of 1 in 160 against this organism only and no other dysentery bacilli.

### 3. An unusual case of Actinomycosis of cheek.

G. PANJA, Calcutta.

The disease occurred in a Hindu male, aged 36 and affected the left cheek over the malar prominence (photo). It was characterised by a reddish, painful swelling of six months' duration, about an inch in diameter with softening in the centre. On incision, pus came out, which on examination showed fine whitish granules and no pyogenic micro-organisms. In the granules fine branching filaments as well as bacillary and coccoid forms of organisms were seen. An actinomyces, Gram-positive, non-acid-fast and non-sporing was isolated in pure culture aerobically on nutrient agar, blood and serum media and no other micro-organisms. Growth was slow and in about 2 weeks, a large elevated colony developed about 2 mm. in diameter, with irregularly lobular margin and radially striated periphery. It liquefied Loeffler's serum. In a hanging drop preparation in serum broth, fine branching mycelial filaments, some tortuous, were seen (photo). The causative organism is undoubtedly an actinomyces but cannot be identified with any known species.

The lesion was confined to the skin only and had no connection with the adjacent teeth or the antrum. It improved with potassium iodide but final cure was obtained by scraping and X-ray exposure.

### 4. Role of Palkies (a type of moving religious fair) in the Epidemiology of Cholera.

S. RAGHAVENDER RAO, Hyderabad-Deccan.

A type of a moving religious fair (PALKI) is described in connection with the Ashad Fair at Pandharpur. The Palkies accompanied by thousands of pilgrims pass through several administrative units *viz.*, Central Provinces, H. E. H. the Nizam's Dominions and Bombay Presidency. They take usually more than a fortnight to reach their destination and approximately the same period for their return journey, usually through a different route. In the past, these palkies were responsible both for the introduction of cholera infection at the Pandharpur fair as well as for the spread of the infection in the areas through which they passed. Elaborate sanitary arrangements are necessary to prevent such occurrences and in this paper it is described as to how such arrangements prevented the spread of cholera through one of these palkies which started from a heavily infected place. Anti-cholera inoculation of the whole lot of the accompanying pilgrims, attention to general sanitary arrangements, including the disinfection of water supplies at halting places, both before and after the arrival of this Palki procession, are suggested to be mainly responsible for this prevention.

### 5. Incidence of gastro-intestinal disorders in relation to drinking water sources in the Singur Health Centre Area (Bengal).

S. C. SEAL, Calcutta.

During the period between July, 1944 to June, 1945 an investigation involving 93 families with 784 individuals and distributed over 11 villages of the Singur area was conducted mainly under three lines, *viz.* (i) the detection of the existing carrier state, its nature and distribution, (ii) collection of epidemiological histories of gastro-intestinal disorders for at least one year and (iii) study of the incidence, nature and seasonal trend of diarrhoeas and dysenteries among the population in relation to the drinking water sources. These sources numbering 23 consisted of 8 open surface wells and 15 tube wells. The results obtained were as follows:

The gastro-intestinal morbidity rate was 20 per cent (excluding dyspepsia), the incidence of diarrhoeas and dysenteries contributing about 15 per cent. The contributions of various infections being as follows: dysentery group—5.4 percent, salmonella—7.2 per cent, *E. histolytica*—9.0 per cent, giardia—11.0 per cent, hookworm—10.2 per cent (without special technique being employed). Clinically, bacillary dysentery greatly predominated, amoebic dysentery being less common. The carrier rate, on the other

hand, was higher for amoebic dysentery (9.0 per cent) than for bacillary dysentery (5.4 per cent). *Bact. shigae*, *Bact. flexneri*, *Bact. sonnei*, salmonella and Giardia infections explained most of the cases.

Multiple cases in families were not common (less than one-sixth). There was no significant difference to the incidence of gastro-intestinal disorders between family contacts and non-contacts.

There was no evidence to suggest any relationship of the gastro-intestinal disorders with the sources of drinking water supply or with their coliform content. In fact, the tube wells (even with a very low coliform flora) were associated with comparatively larger number of cases relative to population than open wells (with high coliform flora).

## 6. Bacteriological investigation into the epidemic of Cholera of May, 1945, at Lucknow.

A. MUKHERJI, Lucknow.

Twenty-four sporadic cases admitted into the Infectious Diseases Hospital, Lucknow, suspected to be of cholera, were examined during April, 1945. Vibrios were isolated from the stools of nine such cases and eight of them were agglutinated only with monospecific "Ogawa" variant type of anti-serum. These vibrios produced greenish haemolysis around their colonies on blood agar plates (made with goat's blood) at 37°C within 3 hours. They fermented saccharose, mannitol, maltose and glucose but not lactose and arabinose.

Cholera broke out in an epidemic form from the 1st of May, 1945 and bacteriological investigation was undertaken from the afternoon of the 4th May, 1945.

Stools from 111 cases, clinically diagnosed to be cholera, during the epidemic of May, 1945 were examined for vibrios. 43 strains of vibrios were isolated from those cases and of these twenty-five were agglutinable. Eighteen of the agglutinable strains were tested with monospecific sera and all were agglutinated with "O" Ogawa anti-cholera serum, 4 also with "O" Inaba anti-cholera serum. Thirteen of the strains agglutinable with "O" Ogawa anti-cholera serum which were tested belonged to the Heiberg's type I, were *Greig-positive* for haemolysis and were agglutinated with specific anti-serum after being heated for 3 hours at 56°C.

## 7. Infantile Cirrhosis.

K. NARAYANA MURTHI, Madras.

A survey of 465 cases of Infantile Cirrhosis under observation of the author was made. Etiological factor in the causation was discussed.

The treatment with gonadal extract and antuitrin was found to be beneficial. The author adduced evidences to show that zinc, mercury and sulphur seemed to have the property of stimulating the gonads or the anterior pituitary and the beneficial effects of zinc that are noted in a few cases are ascribed to stimulation of the gonads by zinc.

## 8. Infective Hepatitis.

K. NARAYANA MURTHI and Y. S. JOHNSON, Madras.

Clinical signs, symptoms and laboratory investigations in a case of infective hepatitis are reported. It was an acute case and developed very severe symptoms of cholaemia. No drugs were of any avail and the patient died.

A post-mortem examination was conducted; the naked eye and microscopical appearances of the tissues are described.

An attendant who assisted the post-mortem developed jaundice within 4 days after the post-mortem, thus suggesting the infectious nature of the disease. He is progressing satisfactorily.

## 9. \*Sporotrichosis of the skin in India.

D. PANJA, N. C. DEY and L. M. GHOSH, Calcutta.

(Mycological Inquiry, Indian Research Fund Association).

In a tropical country like India, where dermatomyces is so prevalent, the incidence of cutaneous sporotrichosis may be expected to be common but in the literatures

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\*The work was financed by the Indian Research Fund Association.

available here records of a few cases are found. It is too early to state whether the scarcity of the reports on this subject is due to the rarity of the incidence of the disease or its non-recognition or failure to report by the physicians. The first case was recorded by one of the authors (Ghosh, 1932). The record of the out-patient department of the Calcutta School of Tropical Medicine shows 12 more cases of cutaneous sporotrichosis diagnosed clinically during the last 15 years but in these cases the clinical diagnosis appears to be not confirmed by laboratory examinations.

The incidence of sporotrichosis as recorded in other countries is more common amongst the farmers, gardeners, etc. and the present case is an Indian female, a vegetable dealer by profession.

While confirming the clinical diagnosis by laboratory methods it was found that the fungus under investigation could not be identified with any of the known pathogenic species of sporotrichum described in the textbooks. The detailed mycology has been studied and this new fungus has been named *Sporotrichum tropicale*, Panja, Dey and Ghosh, 1946.

# 10. \*Studies on Ringworms, Part IV. Incidence of *Trichophyton gypsum* in India.

L. M. GHOSH, N. C. DEY and D. PANJA, Calcutta.

(Mycological Inquiry, Indian Research Fund Association).

Incidence of *Trichophyton gypsum* (small-spored, ectothrix trichophyton) is recorded for the first time in India. Seven cases were studied.

## A. Hair infection (ectothrix)

Beard ...	...	...	...	2 cases
Generalised infection	...	...	...	1 case
Scalp ...	...	...	...	1 case

## B. Skin infection.

Interdigital spaces ...	...	...	...	2 cases
Nail infection ...	...	...	...	1 case

When recently isolated the fungus had typical granular type of growth. The end organs of the fungus had characteristics of the species *T. gypsum* and showed short stumpy fuseaux, dense masses of aleuriospores in groups (grappes and thyrsi) and spirales of various forms.

From study of these seven strains of the fungus it has been observed that the same fungus in different media and under different conditions of growth may show variations in the formation of its end organs.

The present study points towards *Trichophyton gypsum* being a single species and the many variants described in the literature are but the growth of the same fungus under different conditions.

# 11. Athero-sclerosis with special reference to systemic embolic phenomena.

H. I. JHALA, Bombay.

10,000 autopsies were reviewed since 1882 up to date. 2,823 of these (28%) showed no atheromatous lesions or lesions negligible for record. 2,705 (27%) showed atheromatous lesions of severe or very severe character. 4,472 (45%) showed lesions of insignificant type. Out of the 2,705 cases of advanced athero-sclerosis reviewed, there is evidence of lesions definitely due to an embolus of athero-sclerotic origin in 26 and there are 99 cases where an embolus of athero-sclerotic origin might also have presumably occurred. All cases of infarctive lesions in the autopsies have been carefully analysed. Though the percentage incidence in the post-mortem room work will vary according to the group of cases available for autopsy at a place, our figures show that the incidence of advanced athero-sclerosis is 27% and 5% from this group shows embolic lesions. It seems justifiable to presume that in the absence of a definite source of the embolus in cases where the embolic process is the cause of a lesion, athero-sclerosis of a severe character, if present in the case, should be taken as a sufficient reason for explanation and a careful search of occluded vessels and thrombus should be made by a serial routine and frozen sections to demonstrate the lipid cholesterol in the occluded vessels together with the associated phenomena already described. If this plan is adopted the diagnosis of embolic process arising from athero-sclerosis will be clinched.

\*The work was financed by the Indian Research Fund Association.

## 12. Arterial Hypertension.

J. N. MAITRA, Calcutta.

1. *Introduction*—The subject of Arterial Hypertension is rather better discussed from the point of view of the popularly known term as Blood Pressure. Now-a-days blood pressure means a high pressure, but it must be physiologically impressed that the minimum of 90 mm. of mercury of systolic pressure must be maintained to have basal functions of the organs of the body. Studies in metabolism have revealed miraculous facts that previously once a hyperpetic is sometimes a diabetic, a few years later gouty and terminating in something else.

2. *Aetiology*—Various factors are involved in considering the problem of elevation of pressure in individuals. The first type of the series is that detected accidentally in a healthy person who has never been sick or sorry. There is no arterial change, no cardiac embarrassment, urine showing no abnormal activity of the kidneys. We find this type forming a group in so-called work-hard people who had been good sportsmen or athletes in their schools and colleges. The second group belongs to the type of arteriosclerotics, whose family history would tell you that some one began with heart troubles and others with renal complaints. Then there is the third type with associated history of high tension with some definite intoxication or in association with either kidneys or heart giving enough notice of a serious disfunction.

3. *Pathology*—Without a definite deviation from the normal physiological process pathological study becomes a subject of repetition. In addition to fibro-muscular changes in the syncytium studied clinically and electrocardiographically, thickening of the aorta and big arteries, atheromatous changes in the arteries and sub-endothelial tissues as a result of infective agents, there is a variety where a selective change has been found in the coronary arteries either alone or in association with other systemic arteries. Among these are found occasionally sudden deaths.

4. *Clinical manifestations*—There may be no symptoms at all or clinically beginning from most trivial symptoms down to rupture of a main functioning artery leading to signs and symptoms that we all know.

5. *Treatment*—Before treatment begins perfect history and clinical findings are essential. There are medicines for blood pressure thousand and one, if one opens the morning papers. Such habits should cease and we clinicians must spend more of our time in managing physiologically all types of cases with sufficient safeguard for specific causes needing specific therapeutic remedies.

## 13. Preservation of milk as a solution of the milk problem in India.

N. V. JOSHI and R. V. GHATE, Poona.

The towns and cities in India are suffering from a shortage of milk on account of the difficulty of transport of milk from villages to the centres of delivery. This difficulty could be overcome if milk is preserved in such a way that it cannot be spoiled even if the interval between the time of milking and the time of delivery of milk to the customers is extended to any length. Attempts were made to achieve this by destroying all micro-organisms in milk without raising its temperature to more than 100°C. by observing the time of germination of spores of organisms causing spoilage and killing the vegetative cells so germinated. These have proved successful and a method of treating "whole" milk, "separated" milk and "evaporated" milk so as to preserve them for any length of time has been devised. This has proved successful in practice. Some interesting results on the germination of spores of different organisms have been obtained in the course of these experiments.

## 14. Studies on gastric analysis with different test meals.

R. N. CHAUDHURI and M. N. RAI CHAUDHURI, Calcutta.

Gastric analysis is of value in the investigation not only of gastro-intestinal cases but also of other conditions, *viz.*, anemias, pellagra, asthma, etc. In this test, after the removal of the residual juice the gastric glands are excited to secrete as a response to the ingestion of a test meal of which oat-meal gruel is the old standard one. It has, however, certain disadvantages: it takes considerable time to prepare the meal; the patient finds it inconvenient to swallow it while the Ryle's tube is *in situ*; a pint of gruel causes much dilution of the gastric juice; and at times difficulty is experienced in drawing the samples through the tube. More recently alcohol test meal has replaced the gruel meal, as it is easy to prepare and easy to pass it through the tube; the samples are clear and are withdrawn with ease while there is very much less dilution of the gastric juice. Besides it is a gastric stimulant,

although, of course, not a natural one at least in most Indian patients. Not infrequently objections are raised by certain patients against alcohol being put in their stomach. The object of the present study was therefore to perform gastric analysis with various common articles of meal and compare the results with those of the alcohol meal.

This report deals with 200 gastric acid secretion studies performed on 100 patients in the Carmichael Hospital for Tropical Diseases, Calcutta. They were divided into ten groups of ten patients each. Each was given both types of meal—the alcohol meal first and, then at an interval of a few days, the meal to be tested, and the results were compared. The following is the list of different meals used :—

- |                         |                   |
|-------------------------|-------------------|
| (1) Tap water.          | (6) Tea infusion. |
| (2) Distilled water.    | (7) Milk.         |
| (3) Pyrogen-free water. | (8) Olive oil.    |
| (4) Normal saline.      | (9) " Rasam."     |
| (5) Pepper water.       | (10) Alcohol.     |

The results are interesting; even with simple tap water as a test meal, the acid response and the mean curve were almost similar to those of the alcohol meal.

## 15. An inquiry into the possibility of utilization or hygienic disposal of textile wastes.

C. V. SABNIS, Calcutta.

Growth of industry in India has brought in its trail the vexing problem of the so-called industrial wastes. Such wastes consist of the various chemicals used during the manufacturing processes, the resultant by-products and the enormous volumes of wash waters constitute not only an economic loss but also create a complex problem of their hygienic and sanitary disposal. In India little attention has so far been given to the problems of industrial wastes.

A brief enquiry along such lines is reported. Experiments were carried out with a view to possible re-use and recovery of the chemical constituents in the concentrated textile kier liquors and dye wastes or alternatively their disposal. Lime, iron salts, calcium chloride, alum etc. were tried as chemical precipitants. Laboratory filtrations as also aeration were tried with a view to clarification.

The average alkalinity of such liquors ranged between 0.4—1.0 per cent. It was found that lime alone did not clarify such wastes. In combination with iron salts or calcium chloride, clarification and color removal are satisfactory enough for disposal by dilution method. Clarification or color removal beyond this limit required however large doses of the precipitants. Progressive addition of coagulants results in the destruction of alkali and in the increase of neutral salts of sodium. These two factors and the cost of the chemical coagulants would have to be considered if the object of purification is to re-use such liquors.

Filtration through lime or gypsum, partially clarify such liquors and may prove satisfactory for disposal purposes. Chemical nature of the alkalinity of such liquors was studied and nearly one-third was found to be due to complex organic salts of sodium. Experiments to convert such salts into alkali, in an attempt to recover the wastes as caustic alkali, showed that large amounts of lime would be necessary for conversion and that the conversion beyond about 60% would be impracticable.

Finally aeration as a means of clarification did not prove successful.

## 16. Treatment of relapsing cases of malaria.

A. N. BOSE and J. K. GHOSH, Calcutta.

Treatment of relapsing cases of malaria is considered a difficult problem in spite of the various antimalarial drugs available for use. It is known that the benign tertian and the quartan forms of the malarial parasite are the worst which defy radical treatment and lead to repeated relapses, even for years.

During investigation of the antimalarial activity of 2-chloro-7-methoxy-5-(S-diethylaminobutyl)-aminoacridine on *plasmodium knowlesi* infection in monkeys it was casually observed that the relapses, which usually occurred after treatment by the drug, were checked if the animals were injected with an arsenical drug. Continuing this investigation in human cases, it has been possible to develop a method for the radical treatment of relapsing cases of malaria. The method consisted in treating the positive cases primarily with a schizonticidal drug such as alicrin, butyl acridine, or quinine, for a period of 5 days. After 2-3 days, intramuscular injections of arsenosulph (I. R. I.),



a brand of sulpharsphenamine B. P., are started twice a week in the following doses generally :—0.12, 0.18, 0.24, 0.36, and 0.48 gms. A total of 15 cases, all of benign tertian infections have been treated so far. Observations have been made for a period of 6-24 months. No relapse in any of the cases has been recorded.

### 17. The epidemiology of filariasis in the central portion of H.E.H. The Nizam's Dominions. Part II.

M. QUTUBUDDIN, Hyderabad-Deccan.

The study of the epidemiology of filariasis that was undertaken last year was further extended to the two new *taluqs*, Siddipet and Medak of the Medak District situated in the central portion of the State.

In all 1,700 blood smears were taken from 22 villages, out of which 144 were found positive, gross infection rate thus being 8.47%.

A complete mosquito survey was carried out, 17 species of Anopheline and Culicine mosquitoes were collected and dissected. *C. fatigans* is found to be the vector.

The filarial disease rate is almost equal in both the sexes; highest incidence is in the age group of 46—50 years.

The presence of microfilaria in the peripheral blood is remarkably more common in apparently healthy persons than in the pronounced cases. Earliest occurrence of the disease is at the age of eleven and the earliest age at which the infection was detected is one year.

The predominant infection is by *W. bancrofti*.

### 17a. Effect of peptic ulcer on histidine-minimum diet with a case report.

D. M. CHAKRABORTY, Calcutta.

Histidine is present in various food proteins. Certain protein foods like milk whey (milk albumin and globulin) and egg albumin contain histidine in a small amount. A patient with chronic peptic ulcer (confirmed by skiagraphy) with marked hyperchlorhydria was kept on a histidine-minimum diet for 13 days. The pain disappeared on the 3rd day of treatment and skiagraphy showed absence of the ulcer after the treatment was over.

It is presumed that histidine of food-stuffs is converted into histamine-like substance in the stomach which after absorption maintains a high acidity and thereby causes an ulcer in a susceptible subject.

### 17b. Some recent studies and investigations in sterility.

DR. HEM MANGALIK-SANWAL, M.B., B.S., Reader in Obstetrics and Gynaecology, King George's Medical College, Lucknow.

In spite of the increasing birth rate, in India, sterility still remains one of the most distressing human complaints for which patients constantly seek advice. Out of the 8,463 cases that attended the Out-patient Department of Queen Mary's Hospital 1,410.5 complained of sterility. The detailed observations and investigations were carried on 200 cases of primary sterility, mostly from the poor and middle class families, including Hindus, Muslims and Christians. The duration of the infertile marriage was as follows : First three years 64%, between 3-5 years 26.8%, 5-10 years 4.2% and over 10 years 4%. The age incidence showed no feature of importance— $\frac{1}{2}$  being between 16-20 and  $\frac{1}{4}$  between 20-30.

Out of 200 cases 104 cases showed hypoplasia of the uterus with history of scanty, irregular periods and dysmenorrhoea.

In 60 cases tubal occlusion was present. Ten of these cases gave history of gonococcal infection. Five cases had signs of abdominal tuberculosis and in two cases enlarged matted glands were present both in neck and axillae.

19 cases complained of excessive menstrual discharge and pathological investigations left no doubt that these cases suffered from chronic endometritis possibly of tuberculous origin.

Ten patients showed pin point erosion of the cervix and in these cases PH of the vaginal fluid was found to be strongly acid.

In 7 cases no local or general cause for sterility was found in the female patients. From these observations, it seems that congenital hypoplasia of the uterus is the most common cause of sterility. Tuberculosis either of the tubes, endometrium or both seems to be the next important cause.

17c. General principles in the treatment of leprosy with reference to the modern pathological concepts of the disease.

R. G. COCHRANE, Vellore.

Considerable attention has been given towards the drug treatment of leprosy during the last few decades. Hydrocarpus oil (Chaulmoogra oil) and its derivatives have still a certain amount of popularity and in some areas, is still considered the drug of choice. Within the last 2 years, *promin* and *diasone* have come into therapeutic use. The active principle in the newer remedies is di-amino-di-phenyl sulphone and evidence is available to show that this group of drugs along with streptomycin have a definite *in-vitro* action on *M. tuberculosis*. A fairly long treatment from 1 to 3 years is however necessary. Apparently the drugs either individually or on combination with streptomycin cannot reach the bacilli embedded in the tissue in sufficient lethal concentration. There are other drawbacks also in this form of treatment.

Leprosy, like infantile paralysis, and many other mutilating diseases, is first a medical problem and only secondarily a social problem. No final conquest of the disease is possible so long as the leaders of our profession look upon leprosy as a social problem and not of interest to medical men but only to charitable and religiously minded people. Our whole outlook must be changed, and the unfortunate attitude of the public and the profession remedied, for it leads to concealment and a perpetuation of a state of ignorance which is the greatest handicap to effective medical research on this age-long problem.

### Pharmacology and Therapeutics.

18. Potency of international standard digitalis powder after 20 years' storage.

J. C. GUPTA and MADHABLAL CHATTERJI, Calcutta.

Tincture of digitalis made from standard digitalis powder (1926) was tested on cats weighing 1.7 to 2.5 kgm. by Hatcher & Brodie method. Dilution used was (1-20), rate of infusion being on average 1 c. cm. per minute.

On the basis of 17 experiments with this tincture, cat unit was found to be  $17.87 \pm 2.14$ . On a previous examination of 20 cats with 1936 standard the cat unit was  $17.98 \pm 1.9$ . The variation is found on statistical analysis to be of no significance.

"The National Institute of Medical Research, Hampstead recommends that the 1936 standard is to be regarded as 1.25 times as active as the old, without respect to the method of comparison applied". But this could not be corroborated by the present series of experiments which therefore brings out the following facts, *viz.*:-

(1) Either the cats in the tropics are more sensitive especially in the summer months when the present series of experiments were carried out.

(2) Or, the potency in terms of toxicity has increased in the course of these years of preservation.

19. The effect of small doses of sulfanilamide in the treatment of malaria.

J. C. GUPTA and M. L. CHATTERJEE, Calcutta.

A sulfanilamide preparation in tablet form was supplied to us under the name of Nequin. This was tried on 38 ambulatory patients with malarial fever. Blood was examined for parasites in all the cases excepting one. Of these 37 cases, 24 were B. T., 10 M. T. and 2 were of mixed B. T. & M. T. infections and one of quartan infection. A course of treatment consisted of one tablet 0.25 gm. each—three times daily for 7 consecutive days for an adult. The response was encouraging. The majority of the cases became fever-free from the 3rd day of treatment. Parasites from peripheral blood disappeared within 4 to 7 days in all the cases, excepting in 2 cases, one B. T., another of mixed B. T. & M. T. infections. Relapse occurred in a little over 50% of the B. T. cases, and a lower rate of relapse was noticed in the M. T. cases. The 2nd course of treatment was effective to ameliorate the infection in all the cases, excepting in one B. T. infection on which the drug had no effect on either the fever or the parasite. The sexual forms were resistant to this treatment.

20. Comparative studies of different amoebicidal drugs.

J. C. GUPTA and M. M. ALLY, Calcutta.

The authors have studied 74 cases of amoebic dysentery treated in the Carmichael Hospital for Tropical Diseases, Calcutta, with different amoebicidal drugs. All the cases

were selected after repeated demonstrations of *E. histolytica* either in the stool or in the exudation from the bowels collected during sigmoidoscopic examination. Trials of different drugs were undertaken after a thorough investigation into the signs, symptoms and laboratory analysis of cases.

Acute cases with signs of liver and kidney damage were treated with emetine. In this group also were included cases with ulcers in the bowels which were treated with emetine or iodochlorhydroxyquinoline along with chiniofonum enema.

Chronic cases passing mucus with stool with signs and symptoms of liver and kidney damage were tried with carbarsone, iodochlorhydroxyquinoline and diiodohydroxyquinoline. The effect of different amœbicidal drugs is shown below :—

Name of the drugs.				No. of cases.	Cure.	Failure.
Carbarsone	...	...	...	24	23	1
Iodochlorhydroxyquinoline	...	...	...	18	18	0
Diiodohydroxyquinoline	...	...	...	19	18	1
Emetine in combination with other drugs	...	...	...	13	13	0

Statistical analysis of these data shows that the result of treatment with diiodohydroxyquinoline, a new entrant in the field, is as good as others. As the indications and contra-indications of carbarsone as well as iodochlorhydroxyquinoline and diiodohydroxyquinoline are not in agreement, choice of one single drug for all cases is not possible.

## 21. Further observations on the studies of stilbamidine.

J. C. GUPTA and M. M. ALLY, Calcutta.

The remarkable fall of blood pressure (B.P.) after the administration of stilbamidine has greatly precluded its use in the treatment of kala-azar. As the mechanism of the fall of B.P. is not fully explained by previous investigators, further observations on the studies of the action of stilbamidine were undertaken.

The drug has got a slight depressant action on the heart if the dose is small but in larger doses the drug depresses the heart muscle. This depressant action alone cannot explain the fall of B.P.

The cause of immediate fall of B.P. is partly due to the depressant action of the drug on the vasomotor centre in the medulla. This has been shown in the decerebrated and spinal cat where the drug failed to produce a sharp fall of B.P. In animals with intact medullary centres the drug produces always a sharp fall of B.P. Coramine, which is stimulant to the medullary centres, partly restores and prevents the fall of B.P. The fall of B.P. is not due to capillary dilatation as is seen in histamine. The other factor responsible for the fall of B.P. is the damage of the sympathetic mechanism at the neuro-muscular junction. The sympathetic nerve-ending is depressed but not paralysed as in the case of ergotoxin in large doses.

It differs from ergotoxin in its additional stimulant action on the vessel wall. In a spinal cat the drug after a large dose of ergotoxin produced a rise of B.P. In frogs also stilbamidine depresses the sympathetic nerve-endings of the vessels and produces slight dilatation. But if the above nerve-endings are paralysed beforehand with ergotoxin, stilbamidine produces constriction of the vessels.

## 22. A case of suicide with barbiturate poisoning with clinical signs and symptoms of it.

K. NARAYANA MURTHI, Madras.

The patient died and a post-mortem examination was done; the naked eye appearances of the tissues are described.

The urine and stomach contents showed the presence of barbiturate.

## 23. The value of transfusion of blood in the treatment of anæmias.

C. R. DAS GUPTA, Calcutta.

On the basis of treating a large number of cases of anaemia during the last few years in the Carmichael Hospital for Tropical Diseases, Calcutta, it is shown that the essential factors in the treatment of anaemia, irrespective of the degree of anaemia are the adminis-

tration of proper haematinics in suitable doses according to the type of anaemia and treatment of any associated infection, if there be any. Transfusion of blood is a valuable adjunct in the treatment of severe anaemias but transfusion alone is never known to cure anaemia. Judicious administration of proper haematinic alone can, however, cure even very severe cases of deficiency anaemias. In the treatment of anaemias associated with infection, treatment of the infection with suitable drugs and of the anaemia are essential. Here too the value of transfusion of blood is only ancillary. The value of transfusion of blood is however immense in the treatment of anaemias with *hypoplasia of the bone marrow*. These points are fully demonstrated with illustrative case records.

The general idea of relying mostly on the transfusion of blood in all types of anaemia is deprecated. A plea is made for a thorough investigation of all cases of anaemia according to modern haematological technique and of treating the cases on the lines suggested.

#### 24. The use of sulpha-groups of drugs in chronic malaria.

N. K. BASU, Delhi.

Very few references are to be found in the literature for the use of sulpha-group of drugs in chronic malaria. And there, too, the findings are very contradictory and inconclusive. Keeping a systematic observation over 500 cases of chronic malaria, treated with sulpha-group of drugs, I have come to some tentative conclusion that (i) these drugs have very little anti-malarial action, but (ii) in most of the cases of chronic malaria the temperature is prolonged due to some secondary infections, and in such cases these drugs have definite beneficial effect.

#### 25. On the antibacterial activity of *Allium Sativum*.

U. P. BASU and P. SEN GUPTA, Calcutta.

Garlic (*Allium Sativum*) is held in great repute by ancient Indian physicians (*cf. Chopra, Indigenous Drugs of India*, 1933, p. 273). The active principle is a volatile oil but it is not definitely known in which form it is present in the bulbs. Its juice is employed as an antiseptic. Cavallito and Bailey (*Jour. Amer. Chem. Soc.*, 1944, 66 1950) have isolated it in a purer form. Its stability cannot, however, be assured as such a work was undertaken to isolate the active principle by infusion with spirit. Purification of the same by means of ether extraction and subsequent trituration with petrol ether of the residual oil from ether extract afforded a product quite active against Gram-positive and Gram-negative bacteria. Its activity on storage is being further studied with a view to find out whether this simple method of extraction of the active principle may afford a product of real therapeutic value.

#### 26. Some observations on the effect of sulphanilamide derivatives on the dehydrogenase system of resting *Bact. coli*.

A. N. BOSE and N. ROY, Calcutta.

That sulphonamides act as bacteriostatic agents by competing and interfering with the action of certain enzyme systems, particularly the respiratory enzymes is now generally accepted. It is also observed during chemical reactions that one of the hydrogen atoms of the  $\text{SO}_2\text{N H}_2$  group is very reactive. In order to study the reactivity of this hydrogen atom on the enzymes of different bacteria, a number of studies were made with the dehydrogenase system of *Bact. coli*, using the organisms in the resting phase (Quastel, 1926, 20, 166, 545).

It is being observed that while sulphanilamide, sulphacetamide, and sulphanilyl-benzamide cause the methylene blue in the system to be reduced to its colourless form, sulphapyridine acts entirely in the opposite direction. Thus instead of discharging the blue colour of the methylene blue, it brings back the original blue colour, after the methylene blue has already been reduced to its colourless form by the hydrogenase in the system. It is therefore evident that sulphapyridine acts by oxidation of the reduced methylene blue, whereas sulphanilamide, sulphacetamide and sulphanilyl-benzamide act through reduction of the same in an anaerobic system.

#### 27. Further studies on the intestinal excretion of sulphanilamide derivatives.

A. N. BOSE, Calcutta.

In continuation of our previous work on the intestinal excretion of sulphanilyl-benzamide and other sulphanilamide derivatives (*Quat. J. Pharm. Pharmacol.*, 1946

Vol. 19, p.1) further studies have been made with  $N_4$ -substituted compounds, in order to throw more light on the mode of action of antidyenteric remedies. The compounds taken for study were:—

(i) Succinyl-sulphathiazole, (ii) Phthalyl-sulphathiazole, (iii) Succinyl-sulpha-benzamide and (iv) Phthalyl-sulpha-benzamide. It is being observed that all these substituted derivatives except succinyl-sulphathiazole are more or less excreted, as the free unsubstituted compound from the different parts of the intestinal tract, particularly the caecum. This shows that these substituted compounds, to a more or less extent, are liable to be broken down into the parent compound in the system, succinyl-sulphathiazole being more resistant. In conjugated forms however (which also take into account the free substituted compounds) they are all excreted through the intestinal tract. Succinyl-sulphathiazole is excreted mostly from the caecum, the amount of excretion in stomach also being fairly high. With succinyl-sulpha-benzamide both the free and the conjugated forms are excreted mainly from the caecum. Phthalyl-sulphathiazole is excreted from all parts of the intestinal tract, free as well as conjugated, caecum taking the major part in the excretion. Though similar to phthalyl-sulphathiazole in its nature of intestinal excretion, Phthalyl-sulpha-benzamide is comparatively less concentrated than the former.

## 28. Phenyl cellosolve in the treatment of pediculosis.

D. N. ROY and S. M. GHOSH, Calcutta.

Phenyl cellosolve (monophenyl ether of ethylene glycol), a solvent manufactured by Messrs. Carbide and Carbon Chemicals Corporation, New York, has been found to possess marked toxic properties on both adult lice and nits. Davis and his co-workers used it at a much higher concentration than Hensens. The present authors who have experimented with 5 per cent alcoholic solution find it quite efficient for killing not only adult lice but also their eggs.

## 29. Sulphaguanidine in the treatment of cholera under rural field conditions. (a report of 290 cases).

S. C. SEAL, Calcutta.

Thirty small outbreaks of cholera, involving 29 villages in the Singur Health Centre Area, Bengal, were investigated during the period between the middle of August, 1944 and the middle of September, 1945 with a view to ascertain the value of sulphaguanidine in the treatment of cholera cases under rural field conditions.

The special features of the outbreaks have been noted. There were altogether 290 cases affecting all age groups, females preponderating over males. The gross fatality rate was 24.5 per cent, both sexes contributing almost equally. One hundred and thirty-four cases (Group A) were treated with sulphaguanidine with only 2 deaths and 154 cases (Group B) by other methods with 67 deaths, the fatality rate being 1.5 and 43.5 per cent, respectively. The difference is obviously significant. The mortality rates among the moderate and severe cases were respectively 1.9 and 2.6 per cent in Group A against 18.5 and 70.2 per cent respectively in Group B.

The statistical analysis of the data in relation to the various factors which influence the results of treatment indicate a definite superiority of sulphaguanidine over "other treatments." The doses used for a clinical cholera case (adult) were generally as follows:—Initial dose—3 grammes followed by 3 or 2 grammes every 3 or 4 hours (repeated immediately if vomited out) till the number of stools is reduced to 2 or less per day, then one gramme every 6 hours for the next 24 hours. The drug is better used in powder form. The total average dose varied with age, severity and time of commencement of treatment. The highest total dose in mild cases was 14 grammes, in moderately severe cases 25 grammes and in severe cases 28 grammes, the gross average being about 19 grammes. No complications or toxic symptoms developed in cases treated with this drug.

It is emphasised that the drug may be safely kept in stock in every village or city home within the cholera endemic area in the same way as quinine, mepacrine sulphapyridine, etc., for use in all gastro-intestinal troubles accompanied by purging and vomiting, at least as an emergency or first-aid measure.

## 30. Aromatic diamidines in the treatment of Indian kala-azar.

P. C. SEN GUPTA, Calcutta.

Since the synthesis of the aromatic diamidines by Ewins in 1939, four compounds of this group, *viz.*, 4:4' diamidino stilbene, 4:4' diamidino diphenoxy pentane, 4:4' diamidino

diphenoxy propane and 4:4' diamidino diphenyl ether, have been tested for therapeutic efficiency in the treatment of Indian kala-azar at the Calcutta School of Tropical Medicine. On comparison of the results of these trials it has been found that though all of these compounds possess varying degrees of therapeutic activity on kala-azar, 4:4' diamidino stilbene (*stilbamidine*) has proved to be the most valuable, the immediate cure rate being about 98 per cent and the permanent cure rate about 95 per cent. On account of certain immediate unpleasant reactions and the occurrence of a certain sequel due to delayed toxicity, it is not possible to recommend this drug for routine treatment, but it has proved invaluable in the treatment of antimony resistant kala-azar cases, cases complicated with pulmonary tuberculosis and cases showing hypersensitiveness to antimonials.

31. Comparative chemical investigation of some of the constituents of *Rauwolfia serpentina*, Benth., obtained from different sources and isolation of the active resin.

ASHUTOSH DUTTA, J. C. GUPTA, S. GHOSH and B. S. KAHALI, Calcutta.

A comparative study of some of the chemical constituents of the roots of this drug, collected from Dehra Dun, Behar, Bengal and Assam, has been made. The method found most suitable for the assay of the total alkaloids has been described and the values for the roots, stems, and leaves for the Bengal variety noted. Although the hypotensive (blood-pressure reducing) action of the drug may be attributed mainly to the alkaloids present, it has been proved almost beyond doubt that the sedative or hypnotic action is due to a fraction of the resin present, a fact of great significance elicited in the present work. Methods of fractionation and study of the pharmacological action of the different fractions have led to the isolation of the most active component of the oleoresin. Further purification of the active resin is in progress.

32. The antihæmolytic action of certain sulphanilamide compounds.

A. C. ROY, D. C. MAZUMDAR, P. MUKHERJEE and H. K. BISWAS, Calcutta.

The antihæmolytic action of the sulphanilamide compounds has been the subject of some interest during recent years. Levaditi and Vaisman (*Compt. Rend. Soc. Biol.* 1935, 120, 1077) found that sulphanilamides neutralized the hæmolysins and leucocidins of streptococci. Roy, Mazumdar & Mukherjee (*Ind. J. Med. Res.* 28, 235, 1940) studied the action of solu-septasine on some of the common hæmolytic substances such as cobra-venom, bile salts, saponin, and cyclamine *in vitro*, and found that it had a definite retarding action on the hæmolysis caused by them. Bacterial hæmolysins such as those elaborated by *El Tor* vibrio and *streptococcus pyogenes* were also found to be neutralized by solu-septasine. Prontosil also was found to exert a similar antihæmolytic action.

These compounds appear to act in two opposing directions, *viz.* (1) they have a sensitizing action on the red blood cells rendering them more susceptible to the action of the lysin and (2) they have also a neutralizing action on the lysin thereby retarding hæmolysis. The net result is conditioned by the preponderance of one or the other of these opposing forces.

The results of animal experiments, though not in any way conclusive, showed that the mice receiving a mixture of cobra-venom and solu-septasine died sooner than those having cobra-venom alone.

32a. Preparation of new polyvalent anti-snake-venom serum effective against the venoms of Cobra, Russell's Viper, Common Krait and Saw-Sealed-Viper.

A. K. HAZRA, Bombay.

An announcement regarding the preparation of new polyvalent anti-snake-venom serum in horses had been made in a letter to the Editor, *Current Science* (1945) Vol. 14 p. 20. In the present communication the selection of the method of immunization of the horses against the venoms is described. For immunization two methods suggest themselves:

- (1) Injection of a mixture of all the four venoms into one and the same horse, or
- (2) Injection of individual venoms into individual horses.

The first method showed definite advantages over the second.

Having selected the method of immunization, the method of administration of the venoms was evolved. It was found that initially the venoms were best tolerated when they were injected subcutaneously in a dilution containing 1 mg. of the venom in 100 c. c.

of physiological saline. When the horses developed in them considerable amounts of anti-venom, their tissues could tolerate a more concentrated solution of the venoms without undergoing necrosis. Hence, during the later stages of immunization, when large doses of the venoms had to be administered, the venoms were administered in a concentrated solution. Selection of the dilution of the venoms which would be suitable for the horses was always controlled by previous experiments in rabbits. The detoxication of venom solution for immunization was in no way found to be more helpful.

When the sample of blood from immunized animals is found up to the required titre the bleedings are made.

The serum is assayed on mice as suggested by Ipsen (1938). The important condition which the assay satisfies being that it determines "the relation between the antitoxin and the venom, irrespectively of the level of test chosen."

To meet the disadvantages of high temperature prevalent and storage difficulties the serum is issued in lyophilised form by drying from the frozen state.

### Pathology, Microbiology and Parasitology

#### 33. A note on estimating hæmoglobin with one cubic millimeter of blood.

M. N. RAO and G. KARMAKAR, Calcutta.

The common methods of estimating haemoglobin in blood require at least the use of about 20 c. mm. of blood. It is difficult to draw repeatedly such large amounts of blood from small laboratory animals like rats and mice. A method is described which can be applicable in these cases and wherein one cubic millimeter of blood only need be used for haemoglobin estimation. This method can incidentally be used to estimate haemoglobin from haemocytometer fluid left out after an R.B.C. count.

This method utilises the well-known pseudo-peroxidase reaction of haemoglobin. The purple colour developed in the unknown sample is matched in a Pulfrich photometer with a standard.

#### 34. Further improvement in the D.E.C. medium (Panja & Ghosh) and its presentation in a dehydrated form for ready use.

G. PANJA and S. K. GHOSH, Calcutta.

Sodium taurocholate 0.85% in the original D.E.C. medium was partly replaced by sodium desoxycholate to yield better growth of intestinal pathogens. Complete replacement could not be done, as there was haziness around colonies of the pathogens. It was not possible to reduce ferric citrate below 0.3% to get a better result.

The improved medium has sodium taurocholate 0.45% and sodium desoxycholate 0.10%.

Dehydrated medium was prepared in the following way: peptone and lemco were made up into a paste with a minimum quantity of distilled water, the rest of the individual constituents were ground up with pestle in a mortar and powdered agar was then added. 20 c.cm. of rectified spirit were added to 100 gms. of the mixed powder and finally the indicator, neutral red and 1 c.cm. of normal caustic soda. The whole mixture was stirred, kneaded, warmed and at once put into a vacuum desiccator where dehydration was carried on under 3 hours' continuous vacuumisation.

To prepare the medium, a quantity of 7.5 to 7.6 gms. of the desiccated powder is to be soaked in 100 c.cm. of distilled water for some time and then boiled for about a minute only and poured into Petri dishes.

The medium prepared in this way was found superior to Difco SS agar in the isolation of all intestinal pathogens—Salmonella, Shigella and Vibrios.

Introduction of this new dehydrated medium on a commercial scale in India is suggested.

#### 35. Further work on the analysis of flagellar H-antigens of vibrios by the method of motility test.

G. PANJA, Calcutta.

It has been reported by Gardner and Venkatraman that the flagellar H-antigens of all cholera, para-cholera and saprophytic vibrios are identical and for the purpose of identification of cholera vibrios specific somatic O sera are therefore required. Last year, in the Indian Science Congress at Bangalore, a paper on a new approach to the

analysis of H-antigens of vibrios by the motility test in immune serum agar was sent by the author. This showed that the H-antigens of cholera and El Tor vibrios were identical but dissimilar from those of the non-agglutinable para-cholera and saprophytic vibrios. Moreover, the antigens of the latter-group of vibrios were divergent according as their O components.

The work was extended this year by carrying out not only the macroscopic motility test in immune serum agar but also checking the result by a more delicate and accurate microscopic motility test under ordinary as well as dark ground microscopes with un-absorbed and absorbed sera. For example, Inaba sub-group vibrio serum unabsorbed shows complete inhibition of motility of Inaba, Ogawa and El Tor vibrios both macroscopically and microscopically but fails to show any inhibition of motility of eleven strains of non-agglutinable (NAG) vibrios indicating thereby that the H-antigens of the above known pathogenic vibrios are identical but different from those of NAG vibrios; *vice versa* a NAG vibrio serum arrests motility of the homologous NAG vibrio but is inactive against heterologous NAG vibrios and Inaba, Ogawa and El Tor vibrios proving thereby that the H-antigens of NAG vibrios are not only different from those of Inaba, Ogawa and El Tor vibrios but also dissimilar amongst groups of themselves as are their O components.

Inaba serum absorbed with Inaba vibrio fails to arrest the motility of all vibrios including the non-agglutinable ones—macroscopically and microscopically but when absorbed with a NAG vibrio retains its full power of inhibition of motility of Inaba, Ogawa and El Tor vibrios excepting that of the NAG vibrio, thus corroborating the above conclusion.

Similarly a NAG serum absorbed with Inaba vibrio inhibits the motility of the homologous NAG vibrio but is inactive against Inaba, Ogawa, El Tor and heterologous vibrios.

Besides, when an Inaba serum is absorbed with Inaba vibrio, the supernatant fluid after centrifugation becomes completely clear, whereas when it is absorbed with a NAG vibrio, the supernatant fluid remains opalescent even after prolonged centrifugation. This indicates that the flagella of the NAG vibrios being not agglutinated are still in the fluid, in a broken state, although the bodies of the vibrios have gone down due to high centrifugation. Microscopically also, very scanty vibrios are found in the fluid.

All these experiments corroborate the last year's conclusion that the H-antigens of NAG vibrios are not identical with those of the cholera vibrios and are also dissimilar amongst themselves. It is found as a rule that wherever there is O-identity, there is also H-identity.

It is for this reason that exclusion of the H-antigen by a laborious process is not indicated when preparing diagnostic cholera sera. Diagnostic cholera combined H & O sera prepared with pure strains of cholera vibrios and suitably diluted have been tested by the slide method of agglutination on a large number of vibrios isolated from clinical cholera cases but not a single NAG vibrio has hitherto been found agglutinable with such sera by the above method of test.

It is also found that the microscopic motility test is a more delicate method for determination of complete absorption of vibrio sera than the Dreyer's method of agglutination.

36. A non-motile El Tor vibrio possessing the antigens of *Vibrio cholerae* both Inaba and Ogawa sub-types.

G. PANJA, Calcutta.

This vibrio was recovered while examining stools from suspected cholera cases in a hospital in Calcutta. The organism is non-motile, when examined microscopically under dark ground illumination and macroscopically by stab method in semi-solid deep agar. A serum raised in a tested rabbit free from Inaba and Ogawa agglutinins, agglutinates Inaba to a titre over 1 in 12,800 and Ogawa to 1 in 3,200.

That the serum is a pure O-serum is indicated by the following facts:—

(1) The serum readily agglutinates live Inaba and Ogawa sub-types of cholera vibrio but the clumps formed during agglutination with a diluted serum are still motile under the microscope, observed for 2 hours, whereas similar clumps formed with either Inaba or Ogawa combined H & O serum become absolutely non-motile in a few seconds and continue to remain so.

(2) In a stab culture preparation in semi-solid agar incorporated with suitable quantities of the above serum, clumps are seen in the stab line and offshoots of growth are also seen later after 24 hours from the stab line with Inaba and Ogawa vibrios indicating that the serum contains O agglutinins only and no H that will hinder motility.



With this strain, it has thus been possible to prepare easily diagnostic cholera O sera (Inaba & Ogawa combined) of a high titre. By absorption of such serum, pure Inaba & Ogawa O-sera of high titre have also been prepared.

### 37. Media prepared with infusion of pulses in place of meat infusion.

C. L. PASRICHA, G. PANJA and S. K. GHOSH, Calcutta.

Pulses such as white peas, horse gram and soya bean with husks intact were well washed in water and then allowed to soak over-night at room temperature in distilled water. The water after infusion was strained, boiled for one hour and to this were added dibasic potassium phosphate 0.4% and sodium chloride 0.1%. pH was adjusted to 7.4 to 7.6 with normal caustic soda and the fluid medium so prepared was sterilised in an autoclave for 30 minutes at 121°C. For the preparation of solid media, China grass was added as in nutrient agar.

A preliminary experiment showed that broth made with white pea infusion was on the whole better for the growth of Gram-positive and Gram-negative bacteria than nutrient broth, casein broth, peptone water, and broth made with an infusion of either horse gram or soya bean. *Streptococcus pyogenes* and pneumococcus grew very well in the medium.

Solid media prepared with the above infusions and agar showed practically the same results, soya bean being the least satisfactory.

Unclarified infusions showed richer growth of bacteria than clarified ones and allowed even laboratory cultures of gonococcus to grow but the disadvantage was that the phosphate was thrown down at the bottom, rendering the medium cloudy on shaking.

Clarified broth made up with the phosphate and sodium chloride but without peptone was found superior to nutrient broth and gram broth and allowed pneumococcus, streptococcus, gonococcus and diphtheria bacillus to grow. One disadvantage was that pH of the medium fell to 6.0—6.5 when bacteria grew because of the fermentable carbohydrates being present in the infusion and viability of the majority of different micro-organisms was absent and the medium could not be used for differential isolation and for keeping stock cultures. Fermentable carbohydrates could not be eliminated by digestion with hydrochloric acid and papain. On the addition of Bacto peptone 0.5% to the medium, a still better result was obtained.

Solid medium with agar was on the whole not so satisfactory as the liquid medium but when the process of infusion was carried on for two days and the fluid was concentrated to half, the medium prepared with or without the addition of peptone gave practically the same result and was superior to nutrient agar. One disadvantage of the solid medium was that pneumococcus, gonococcus and diphtheria bacillus grew feebly as fine colonies but still the advantages on the whole were : (i) omission of more costly meat, (ii) exclusion of peptone at will, (iii) avoidance of egg for clarification, (iv) satisfaction of religious sentiment of some section of Indian people, (v) less laborious process of preparation and (vi) possible use of the peas as food subsequent to preparation of the medium.

### 38. Antigenic composition of *Bact. typhosum* studied by the action of specific phages.

N. SESHADRINATHAN, Guindy, Madras.

The antigenic composition of six strains of *Bact. typhosum* isolated from cases of typhoid fever by blood culture was studied by first obtaining primary phages from sewage. Secondary resistant strains were obtained by using the primary phages; subsequently phages for the secondary strains were also isolated. The secondary phages were then made to act on the secondary resistant strains and further resistant strains were obtained. The six strains initially used gave rise to twelve other strains whose behaviour towards agglutinating sera for Vi, H and O antigens has been studied.

### 39. Observations on the susceptibility of *Anopheles culicifacies* to infection by malarial parasites.

L. B. SIDDONS, Calcutta.

.(Entomological Inquiry, Indian Research Fund Association).

The combined data of the few inconclusive experiments of earlier workers and of several experiments of the author on the comparative susceptibility of *A. culicifacies* and other anopheline mosquitoes gave the following results in respect of the gland and

total infection rates (percentage infected) of six species: *A. annularis*—69.2 and 88.9; *A. stephensi*—64.2 and 71.4; *A. culicifacies*—25.7 and 33.3; *A. varuna*—11.8 (gland rate); *A. subpictus*—1.0 and 6.7; *A. barbirostris*—0 (gland rate). The high degree of susceptibility of *A. annularis* is interesting, as it does not accord with the natural vectorial behaviour of this usually numerically prevalent species, suggesting that it is mainly zoophilous. *A. culicifacies*, the most important vector in the Indian sub-continent, is a comparatively weak host to *Plasmodium vivax* and *Plasmodium falciparum*, when *A. stephensi* is taken as the standard of susceptibility. Analysis of the author's data did not reveal any differential susceptibility of *A. culicifacies* to the three common parasites. No correlation was observed between gametocyte density and infection rate. The experimental findings help towards an understanding of the natural vectorial status of *A. culicifacies*, particularly instances in which low infection rates have been recorded in combination with high anthrophilic indices.

### Nutrition and Biochemistry

40. Observations on the effect of nicotinic acid in experimentally diabetic animals and in diabetic patients.

SACHCHIDANANDA BANERJEE and NARESH CHANDRA GHOSH, Calcutta.

Contradictory reports appear in literature regarding the effect of nicotinic acid on the blood sugar of normal and diabetic patients. The effect of nicotinic acid on the blood sugar, glucose tolerance curve, urinary excretion of sugar and nicotinic acid was studied in normal rabbits and rabbits made diabetic by intravenous injections of alloxan. The effect of intravenous injection of 300 mg. of nicotinic-acid-amide on the blood sugar of diabetic patients was also studied. Nicotinic-acid-amide had no effect on the blood sugar of diabetic patients. In normal rabbits it had no effect either on the blood sugar or on the glucose tolerance test. In diabetic rabbits nicotinic acid caused a rise in the blood sugar. It, however, had no effect either on the glucose tolerance test or on the urinary excretion of sugar. Urinary excretion of nicotinic acid was not altered when the rabbits were made diabetic. Nicotinic acid, however, prevented the diabetogenic action of alloxan when injected just before the injection of alloxan. If diabetes is caused by the defect in the metabolism of purines and alloxan, nicotinic acid might combine with alloxan thereby preventing its diabetogenic effect. Nicotinic acid might then play some part in the prevention of diabetes and not in its amelioration.

41. The use of ground-nut cake flour for human consumption.

M. B. DAVER, Hyderabad-Deccan.

The paper deals with the possibility of making use of "ground-nut cake flour" for human consumption with a view to meet the cereal shortage.

It has been found that the flour can be mixed with the flour of any cereal, millet or pulses in proportion of 25 to 30 parts, for making *chappaties* and other culinary preparations. For making loaf it can be used in proportion of 15 parts with baker's flour. If used in higher proportions, it gets rancid.

All preparations made out of this flour have sweetish taste and therefore require addition of a little more table salt. Its preparations are indistinguishable in taste from those made of wheat flour.

It is superior to wheat in its vitamin B complex. Thus it becomes an ideal addition to the Indian diets, as most of them are poor in protein, mineral and vitamins particularly vitamin B complex.

Preparations made with ground-nut cake flour do not cause diarrhoea, as believed, nor has any deleterious effects on the digestive system.

Its repulsive smell could be removed, if only good, graded, selected and handpicked seeds are used. If the skin from the nut is removed, before crushing them in the expeller, the cake is whiter and has no smell. In spite of the additional expenses the flour could be sold at comparatively cheaper rate. Its use can serve three great purposes:

1. At cheaper rate the public can have flour which is as nutritious as any other flour.
2. There will be great saving in rationed grains.
3. Its use can make up to a great extent the qualitative defects of poor Indian diets.

42. Significance of "Trace Elements" in human nutrition.

K. N. BAGCHI, Calcutta.

Careful analysis of human hair has shown that certain elements such as lead, arsenic, nickel, cobalt, zinc, manganese, boron, silicon, etc, are present in appreciable amounts

in hair of all nationalities (Bagchi and Ganguly, *Ann. Biochem. & Exptl. Med.*, 1941). Hair appears to serve as a depot where the elements are dumped for elimination. The importance of these elements in human nutrition has not yet been sufficiently realised, but it is being slowly worked out. The idea that their presence is a mere accident and has got no biochemical significance is no longer tenable. It has been proved lately that an excess of cobalt in the diet of rats produces polycythemia and addition of little ascorbic acid to the extra dose of cobalt prevents this condition. Manganese has been known to influence the formation of phosphatase and to stimulate the carboxylase system. Manganese-free diet produces sterility in rats by degeneration of testes. Manganese has also been shown to help the metabolism by its action on vitamin C (Rudra, *Ann. Biochem. Exptl. Med.*, 1941). Zinc is recognised to be a useful element but its exact function is not yet known. It may be interesting to know that cobra venom contains as much as 0.7% of zinc (Ray, *Jour. Ind. Chem. Soc.*, 1942).

We are thus confronted with a vast problem—the determination of functions of these “trace elements” in human metabolism. Possibly they act as catalysts—positive or negative, and influence the various body processes, particularly the utilization of vitamins and co-ordination of the enzymes in the tissues.

#### 43. Hippuric acid synthesis as liver function test.

H. I. JHALA, Bombay.

The hippuric acid synthesis as a liver function test was studied in a group of normal individuals and diseased persons.

Oral test was studied in 31 normal persons and venous test in 19 persons. Due to more consistency in results and simplicity of procedure, the venous test was pursued further in a group of 50 abnormal persons. The basis and technique of both tests are described. The normal Indian values obtained are definitely lower than foreign figures.

Main groups of cases studied are :—(1) Infective hepatitis, (2) cirrhosis of liver, (3) congestive cardiac failure, (4) pregnancy toxæmia. Various other cases have also been included as isolated series. The test indicates liver efficiency or detoxication. Figures are incorporated in the paper. Full case histories and laboratory data are given. In a few instances this test has been the only test to fix the correct diagnosis in cases diagnosed otherwise.

#### 44. Effect of cow *ghee* and *vanaspathies* on calcium, phosphorus and protein absorption.

N. D. KEHAR and R. CHANDA, Izatnagar.

Eighteen healthy adult rats were divided into 3 groups of 6 each. They were fed with a fat-free basal ration to which fat was added from different sources (cow ghee, Dalda and Kotogem) at 5% of the ration. Metabolism trials indicated that phosphorus absorption in the cow ghee, Dalda and Kotogem groups was 57, 44 and 35 per cent. respectively; and calcium absorption was 45, 36 and 29 per cent. respectively. The digestibility coefficient of protein in these three groups was 91, 90 and 90 per cent., and the biological value of protein was 73, 58 and 55 respectively.

The above figures indicate that the percentage absorption of phosphorus and calcium in the cow ghee is significantly higher as compared with the Dalda and Kotogem groups. With regard to protein utility, although the digestibility coefficient does not show any difference, the biological value is definitely higher in the cow ghee group.

#### 45. Composition of fish meals and their possible use as stock feeds in India.

S. S. NEGI, Izatnagar.

Twenty samples of fish meal were examined for their organic and inorganic constituents. These included (a) meals prepared from fish of twelve different species, (b) meals from whole fish as well as from such parts as shells, head, liver, etc., and (c) meals prepared from the same fish by different methods, such as “cooked and pressed” and “beach dried.” The meals prepared from whole fish usually contained crude protein from 65.75 to 81.75, lime 1.21 to 9.13 and phosphate 1.80 to 7.83. Samples prepared from shells and head were extremely rich in lime. Significant difference in composition was noticed between samples of same fish prepared by different methods. The “beach dried” samples usually contained considerable amount of insoluble ash. Meals prepared from prawns contained fairly large quantity of sodium chloride.

The widely variable composition of fish meals suggests their suitable blending and grading before these are used in stock feeding. Based on their average protein content one pound of fish meal is almost equivalent to two and a half pounds of a protein concentrate like oilcake.

#### 46. A note on the biological assay of vitamin D in fish liver oils.

G. KARMAKAR and M. N. RAO, Calcutta.

The common laboratory methods of assaying vitamin D are the two biological tests—the “line test” and the “ash test.” For both the tests colonies of rats deficient in vitamin D are to be used. In Calcutta difficulties were encountered in rearing the ideal colony for the purpose. An experiment is reported wherein the two tests are compared under the same adverse conditions. The longer time required for the ash test appears to bring out spontaneous healing. When the stock is not quite satisfactory it is concluded therefore that ash test is not of much value. The line test appears to be the test of choice.

#### 47. Presence of nitrites in the human tissues and its significance.

S. K. CHATTERJI and H. D. GANGULI, Calcutta.

Traces of nitrites are present in the normal human tissues and mucous secretions. It is quite possible that the intestinal bacteria acting upon the nitrates present in the food, reduce them to nitrites which pass into the circulation and different organs. Nitrites may also be formed by some intestinal bacteria causing oxidation of ammonia normally present in intestinal gases.

Cases of poisoning by nitrous fumes are not rare among the people working in factories manufacturing nitric acid, picric acid, nitrobenzene or oxalic acid. Irritation of the nasal and bronchial mucous membrane, severe cough, respiratory difficulty and cyanosis are among the main toxic symptoms manifested in such cases. Death usually takes place from pulmonary oedema and haemorrhage. The cyanosis is due to conversion of the oxyhaemoglobin of blood into methaemoglobin.

Sodium nitrite taken in small doses for a long period may produce mild toxic symptoms like loss of appetite, nausea, digestive disturbances. Cyanosis in such cases may be quite marked and methaemoglobin may be detected both in the blood and the urine. Poisoning by sodium nitrite is fairly common among the people engaged in dyeing and in textile industry. The first authentic case of suicidal poisoning by sodium nitrite was reported from our department in 1930. Such cases of accidental or suicidal poisoning by sodium nitrite are not uncommon.

As traces of nitrites have been found in normal human tissues—detection of a mere trace of nitrite in the tissues in such cases of accidental and suicidal poisoning would be of no value. Experiments were performed to calculate by quantitative estimation the average normal limits of the contents of nitrites present in different tissues in a healthy adult Indian, by colorimetric method and compared with the amount found present in cases of suicidal or accidental poisoning.

#### 48. The esterase and complement activity of the blood in experimental scurvy.

A. C. ROY and P. MUKHERJEE, Calcutta.

It was reported earlier (Roy, *Ind. Jour. Med. Res.* 30, 245, 1942) that the different species of animals could be grouped under four distinct heads according to the relative esterase (butyric) and complement activity of their blood sera. That these two properties did not always run parallel was shown by the fact that a negative or a very low esterase content was sometimes found to be associated with high complement action and *vice versa*. The sera of guinea-pigs showed both strong esterase and strong complement activity. Guinea-pigs were kept on a scorbutic diet and when the symptoms of scurvy were pronounced, the sera showed a marked reduction in complement activity though the esterase activity was only slightly reduced.

### Miscellaneous

#### 49. Place of Chemistry in Medical Education.

K. N. BAGCHI, Calcutta.

The role of chemistry in medical education and research has not yet been sufficiently recognised in this country. In the symposium on “Teaching of Chemistry in relation

to Medicine" held under the auspices of the Science Congress at Bangalore (1946), medical men who participated in the symposium were almost unanimous on the opinion that the kind of education in chemistry which the students of medicine are now receiving is most inadequate.

The existing syllabuses in chemistry (organic, inorganic and physical) in the I.Sc. (medical group) in certain universities or in the pre-registration course in other universities, prescribed for entrants in medical colleges, are far from being satisfactory. Only in Bengal and Madras, organic and physical chemistry (B.Sc. standard) is taught in medical colleges as one of the subjects for the 1st M.B. course. But unfortunately there are indications that Calcutta may lower this standard just to fall in line with the other universities. This shows that the authorities responsible for medical education in India cannot realise the importance of chemistry and other basic sciences in the future development of medicine, or they deliberately shut their eyes to the fruitful vision in front of them for reasons best known to themselves.

They aim at producing only the third rate general practitioners and not the research workers, whom we need most at the present day. It is time that they should get rid of the old ideas regarding the place of chemistry and other basic sciences in medical education and should realise that many complications, which the surgeons and obstetricians (not to speak of the physicians) meet with in their practice (*e.g.*, ileus and toxæmias respectively), are now explained on the basis of an advanced knowledge in chemistry.

In modern medicine, no research worth the name can be taken up by a medical man if he is not equipped with a good knowledge in higher chemistry. This is perhaps the reason why we find that in this country researches in physiology, biochemistry, nutrition, pharmacology, bacteriology, etc., are now carried out successfully by non-medical scientists and medical men are now gradually receding to the background.

It was emphasised in the symposium that we should follow the American Universities which insist on an advanced knowledge in organic and biochemistry as a prerequisite for admission in a medical college. In some well-known universities in the U.S.A., the medical education is essentially a post-graduate one. The entrants join the college after their graduation in chemistry (particularly organic chemistry) and other basic sciences, usually at the age of about 21 and covering a period of three years. This explains the rapid advancement of the U.S.A. and the falling back of the U.K. in realms of medicine and medical research.

The Bhoré Committee have condemned our medical colleges for poor records in research and laid much stress on this question. In order to make the students research-minded, the teachers must have experience in or aptitude for research and to obtain such teachers in future we must see that a number of M.Sc.'s in chemistry and physics with brilliant academic career, are admitted in our medical colleges every year.

Improvements in medical education in India appear to be a hopeless task. The I. M. Council appointed a Committee (1939) to draw up syllabuses for basic sciences for medical education. The committee did its duty nicely. The I. M. C. circulated the syllabuses to different universities. The universities took no action. The I. M. C. kept quiet—nothing was done.

The I. M. C. prescribed the minimum qualification for entrants in medical colleges. The universities interpreted it in their own way, kept chemistry in the background and prescribed syllabuses and regulations specifying number of lectures and other details. The Principals misinterpret the regulation, interfere with the teaching and the students suffer. A senior Principal of a medical college states that he has his doubts if "all that is put down in the printed syllabus is really done in all colleges." Everything is in a chaotic state. No uniformity anywhere—even two universities belonging to the same province do not agree on these fundamental questions.

## 50. Importance of Tellural Hospitals in India.

K. N. BAGCHI, Calcutta.

In a very interesting and thought-provoking article, Greval has suggested the establishment in India of Tellural Hospitals for treatment of Europeans suffering from various forms of syphilitic manifestations and other diseases which are so very common in Europe but rare in India, *viz.*, G.P.I., tabes, disseminated sclerosis, gonorrhoeal strictures, etc. (*Ind. Med. Gaz.*, 81, 254, 1946). Similarly another disease, erythroblastosis foetalis, so far not reported (except one by Greval) in this country "although the Rh— population exists," may be added to the list.

Just as well-to-do asthmatics from the U.K. and the Continent frequently come to Egypt to spend the winter months there, the patients suffering from G.P.I., tabes

and other diseases may likewise come over to India for a tellural cure. "Even couples mismatched in Rh could come over, multiply, and return home" happy and contented, with a large family.

The Indian soil, the sun, the air, the water and the diets are the likely factors for the development in the Indian system of specific resistance to these diseases. As such, patients seeking tellural cure should live in conditions and on diets peculiar to India.

Places like Ambala, Rawalpindi, as suggested by Greval, and other places such as Ranchi, Jubbulpore, Nasik, Lonavla, Ahmednagar, Ajanta, Ellora, Sanchi, etc., may be selected for this purpose. The sylvan beauty of these places as well as their ancient relics and historical background may be additional factors to influence the mind and health of the patients and thus to quicken the steps to recovery. Places with hot or mineral springs such as Monghyr, Khurda Road, etc., may also be considered.

To begin with small comfortable nursing homes with all Western amenities and facilities for up-to-date medical aid (specific treatments) may be started. They may be gradually developed into finest air-conditioned (both hot and cold according to seasons) hotels with attached hospitals, as are found in Baden and other places in Central Europe where the medicinal springs attract people from all over the world.

This is undoubtedly a feasible post-war proposition deserving early attention of those who want to invest money profitably. Co-operation of medical men with the capitalist is most desirable for such ventures. Such institutions are likely to attract tourists from the West and thus to "become centres for international contact and goodwill." Other benefits as derived from the international tourists are obvious.

## 51. A detailed study of the ferric chloride test for Argemone oil.

A. K. SEN, Calcutta.

The writer gives a full report of the work on which his technique of the ferric chloride test for Argemone oil is based. He shows that the different conditions conducive to the sensitiveness of the test are as follows:—

(1) Quantity of an oil adulterated with argemone oil which should be taken for the test—

5 mls. of the oil made the test distinctly more sensitive than 2 mls.

(2) Whether 2 mls. of HCl and rectified spirit or HCl only should be used—

The use of a mixture of 2 mls. of conc. HCl and 0.4 to 0.6 ml. of rectified spirit made the test more sensitive than any other proportion of acid and spirit or the use of the acid only.

(3) The mixing of the ferric chloride reagent—

Mixing by rotating the tubes between the palms instead of the usual method of mixing by shaking gave a very much better result.

(4) The quality of HCl and the temperature of the water bath—

The use of pure concentrated HCl and a simmering or a gently boiling water bath for heating did very well for the test.

## Veterinary Section

## 52. Augmentation of fertility in cows and she-buffaloes by P.M.S.

S. N. LUKTUKÉ and P. BHATTACHARYA, Izatnagar.

With a view to shorten the intercalving period which is usually very long in the Indian breeds of cattle, twenty-two cows and two she-buffaloes were treated with P.M.S. to induce oestrus and ovulation in them. These animals had not shown any symptoms of heat for more than four months since the last calving and at the time of treatment were found to have inactive ovaries. The route of administration of P.M.S. was either subcutaneous or intramuscular and the dosage given varied from 750 I.U. to 2,000 I.U.

Out of the 24 animals four cows and one buffalo were slaughtered 8 to 10 days after the injection. In two animals out of five clear symptoms of heat had appeared after four and six days respectively. Single ovulation had occurred in four out of five animals and a matured ovum was recovered from the left horn of uterus in one cow.

In sixteen other animals oestrus usually occurred between 2 to 4 days after injection and the largest interval was 11 days. In the remaining three cases, however, the interval between injection and first heat varied from 28 to 46 days. In these animals formation of corpus luteum had taken place within a week after the injection as determined by rectal manipulation. This indicates that the induced heat, perhaps, passed unobserved.

As a result of artificial insemination at the induced heat eleven cows and one she-buffalo became pregnant. In four other cases the animals became pregnant when inseminated at the subsequent heat. In remaining three cases, however, oestrus cycle has been restored but repeated inseminations have failed to produce conception.

Three cows have calved at term, 2 females and 1 male.

### 53. Seasonal variations in semen and hæmoglobin and cell volume contents in the blood of bulls.

D. P. MUKHERJEE and P. BHATTACHARYA, Izatnagar.

Seasonal influence on the various physical characteristics of semen samples produced by six Kumauni hill bulls have been studied. Fortnightly collections of two samples from each bull, at an interval of 15 minutes have been made in the artificial vagina throughout a year. The following characteristics have been studied: (i) Colour and consistency, (ii) Volume, (iii) Initial motility, (iv) pH, (v) Number of spermatozoa per c.c.m., (vi) Total number of spermatozoa per ejaculate and (vii) Percentage of abnormal spermatozoa.

Besides the above semen characteristics, the "reaction time" was also observed.

It has been found that during February to April the average semen samples were milky and from August to October cloudy to milky. The average number of spermatozoa per c.c.m. and the total number of spermatozoa per ejaculate reached the maximum level during February to April and the minimum during May to July, but the average percentage of abnormal spermatozoa showed an opposite trend. Average initial motility was highest during November to January and lowest during August to October. The average reaction time was highest during November to January and lowest during February to April. On the whole the quality of semen produced by the bulls in this study was superior during February to April, *i.e.*, in spring, and inferior during May to July, *i.e.*, in summer.

Bi-weekly examination of blood samples from the same set of bulls were also made for determining the contents of hæmoglobin and cell volume. It has been found that correlated with the semen quality the level in the blood of these hæmatological constituents was higher during spring.

### 54. Seasonal variations in the semen of sheep.

D. D. SHUKLA and P. BHATTACHARYA, Izatnagar.

The paper records observations on the seasonal changes in the amount and quality of semen produced by nine rams. Fortnightly collections of two samples of semen at an interval of 15 minutes have been made in the artificial vagina from each ram throughout the year. The following characteristics have been studied (i) Volume, (ii) Colour and consistency, (iii) Initial motility of spermatozoa, (iv) pH, (v) Concentration of spermatozoa per c.c.m., (vi) Total number of spermatozoa and (vii) Percentage of abnormal spermatozoa.

Along with the above characteristics "the reaction time" of the animals at the time of semen collection has also been observed. It has been found that during February to April the average volume, number of spermatozoa per c.c.m., and total number of spermatozoa were highest and the average percentage of abnormal spermatozoa was lowest. These characteristics have been found to have opposite trend during August to October. The average initial motility was highest during February to July and lowest in August to October. Colour and consistency of semen on the average was thickly creamy during February to April and during May to October thin creamy. Average pH was highest during May to July and lowest during November to January.

In this study the quality of semen has been found to be best in spring, *i.e.*, February to April.

### 55. Seasonal variations in the semen of the goats.

D. D. SHUKLA and P. BHATTACHARYA, Izatnagar.

In this paper the authors have recorded the seasonal variations in the physical characteristics of the goat semen. The experimental animals comprised of nine goats and bi-weekly collections of two samples of semen at an interval of 15 minutes were made from each one, for a year. Observations on the physical characteristics of semen which included (i) Visual observation as to colour and consistency of semen, (ii) Total volume, (iii) Initial motility of spermatozoa, (iv) pH, (v) Concentration of spermatozoa per c.c.m., (vi) Total number of spermatozoa per ejaculate and (vii) Percentage of abnormal spermatozoa have been recorded. The "reaction time" was also noted.

It has been found that on an average the semen samples were thick creamy during February to April and remained thin creamy during the rest of the year. During May to July the average volume and pH were highest and lowest during August to October. Initial motility was maximum during February to April and minimum during August to October. The average concentration of spermatozoa per c.c.m. and the total number of spermatozoa reached their maximum level during February to April and the minimum during August to October. The average percentage of abnormal spermatozoa was maximum during November to January and minimum during February to April. The reaction time was maximum during August to October and minimum during May to July.

The quality of semen was found to be superior in this group of animals in spring, *i.e.*, in February to April.

56. A review of artificial insemination work in cattle at Izatnagar.

S. GUHA, M. L. KOHLI and P. BHATTACHARYA, Izatnagar.

The work on artificial insemination in cattle carried out at the I.V.R.I., Izatnagar under the I.C.A.R. scheme has been reviewed. It has been observed that indigenous breeds of bulls can easily be trained for collection of semen in the artificial vagina even with the use of an anoestrous cow. Bulls of some breeds have however, been found to be rather slow. Semen can also be collected from bulls by ampullæ massage method but this has proved unsuccessful in the buffalo so far. Altogether 323 cows and 327 she-buffaloes have been inseminated. The over-all percentage of pregnancy have been 81.7 in case of the former and 66.3 in case of the latter. Both neat and diluted semen, fresh as well as preserved, have been used. Egg-yolk-phosphate and egg-yolk-citrate diluents have been mostly used. In the cow fractions of total ejaculate up to 1/72 have been tried with success and pregnancies have been obtained with semen preserved up to 6½ days. In a large number of cases semen preserved for three days have given 82.9 per cent fertility. In the buffalo fractions up to 1/12 have been successful. The limit of successful impregnation with preserved semen has been five days so far in this species. With three days preserved semen 57.8 per cent fertility has been obtained. The number of inseminations required per conception has been found to be 1.4 in cows and 1.2 in buffaloes.

The various difficulties involved in the practical utilization of artificial insemination especially in connection with its extension in villages have been discussed.

57. A review of artificial insemination work in sheep and goats at Izatnagar.

S. GUHA, M. L. KOHLI and P. BHATTACHARYA, Izatnagar.

The experiences gained in artificial insemination in sheep and goats carried out at the Imperial Veterinary Research Institute, Izatnagar under the I.C.A.R. Scheme have been reviewed. It has been found that rams and bucks of Indian breeds can be easily trained to eject semen into the artificial vagina even when anoestrous females are used. Of the total of 198 sheep and 134 goats inseminated, 148 sheep and 9 goats were done at the Hissar Farm, Punjab. The over-all percentage of pregnancy obtained is 58.3 in sheep and 80.8 in goats. The low percentage of fertility in sheep is due to the fact that 124 ewes inseminated in 1945 at Hissar have given pregnancy results as low as 48 per cent. This may have been due to the insemination not synchronizing with the ovulation in a number of cases. The percentage of pregnancy in the Izatnagar flock however, has been 86.3. Inseminations have been done with fresh as well as preserved semen. Both neat semen and semen treated with different diluents have been successfully used. Semen preserved up to 7 days has produced pregnancy in the ewe, and goats inseminated with 4 days' preserved semen have dropped kids. Pregnancies have resulted with the use of 1/40th fraction of the total ejaculate in sheep and 1/32nd in goats. Of the ewes which became pregnant 86.7 per cent needed one insemination, 7.1 per cent two inseminations and 6.1 per cent three or more inseminations. The corresponding figures for goats are 78.4 per cent., 11.8 per cent and 9.6 per cent respectively.

The advantages of using vasectomized males for the detection of oestrus in sheep and goats have also been discussed.

58. Studies in semen and artificial insemination in poultry.

D. P. MUKHERJEE and P. BHATTACHARYA, Izatnagar.

A detailed description of the technique of collection and artificial insemination in poultry is given.



A study has been made of the semen characteristics of three White Leghorns and an equal number of *desi* cocks. Twenty-five samples were examined from each cock for the following characteristics : (i) Colour and consistency, (ii) Volume, (iii) pH, (iv) Initial motility of spermatozoa, (v) Concentration of spermatozoa and (vi) Percentage of abnormal spermatozoa.

Colour and consistency varied from thin milky to thick milky. The volume ranged from 0.11 c.cm. to 0.9 c.cm. The range of pH was 6.2 to 7.4. The initial motility varied from + to +++++. The range of spermatozoa concentration was 44 millions to 5,560 millions per c.cm. The total number of spermatozoa per collection varied from 5.72 millions to 3,744 millions. The percentage of abnormal spermatozoa varied from 0.7.

Fertilising capacity of semen samples of the two breeds were determined from the percentage of fertile eggs laid by inseminated hens.

Significant difference has been found in volume, number of spermatozoa per c.cm. and the total number of spermatozoa per ejaculate between the two breeds but not in pH and percentage of abnormal spermatozoa.

## 59. Studies on the semen characteristics of Indian breeds of livestock.

D. D. SHUKLA and P. BHATTACHARYA, Izatnagar.

Semen characteristics of five Kumauni hill bulls, one Hariana, one Sahiwal, two buffalo bulls (Murrah and Murrah cross), five goats and five rams have been studied. Twenty-four samples were collected from each excepting the Sahiwal from which eighteen samples were taken.

The following characters have been studied : (i) Colour and consistency, (ii) Volume, (iii) Initial motility, (iv) Total number of spermatozoa per ejaculate. The data for the various measures have been treated statistically.

## 60. Rinderpest among sheep and goats in Assam.

V. R. GOPALAKRISHNAN, Gauhati (Assam).

Details are given of an investigation of rinderpest in two outbreaks, one each, among sheep and goats in Assam. Full particulars relating to the source of infection, nature of the outbreak and localities affected are given.

Symptoms, course, *post-mortem* lesions and means of control are described. Mortality is high *viz.*, 60 to 70 per cent.

Though the disease was first observed among the imported sheep and goats in Assam, the detection of the spread of infection to local animals and also the possibility of further spread, are stated.

Successful transmission experiments with fresh spleen emulsion have been made in healthy bulls and goats to determine the casual factor. Immunity test was undertaken to confirm the disease in one outbreak, using fresh bull virus obtained from the Imperial Veterinary Research Institute, Mukteswar.

As regards correct diagnosis of the disease in sheep and goats, certain difficulties that are usually met with, are discussed citing the observation of others in this country.

The work has been carried out under a scheme of research financed by the Imperial Council of Agricultural Research, India.

## 61. The effect of feeding alkali-treated cereal straws on the growth of young cattle.

N. D. KEHAR and S. C. RAY, Izatnagar.

Feeding experiments were carried out at four regional centres to study the effect on the growth of the young cattle when the straw quota of their day-to-day ration was fed by a pre-treatment with dilute alkali solution. The straws included in the study were of paddy and wheat.

The trial showed that in two centres where the experiment was carried out with paddy straw the calves fed on alkali-treated straws grew at 67 and 74 per cent accelerated rates than those fed with untreated straw. The feeding of alkali-treated straw moreover had no untoward effect on their health. In two other centres where the experiment was carried out with wheat straw the result showed that the calves fed on the alkali-treated straw grew at an accelerated rate of 30 and 192 per cent. The considerable difference on the accelerated growth rates of young animals fed on treated straw at these two centres

was found to be due to the wide variation in the plane of nutrition. The superior plane of nutrition in one centre considerably masked the good effect the treated straw would otherwise contribute towards the growth promotion.

62. Utilization of by-products of starch manufacture from maize as cattle feeds : Part I. The nutritive value of maize cake.

D. G. PANDITTESKERE, S. C. RAY and N. D. KEHAR, Izatnagar.

The sample of maize cake experimented upon was found to contain on dry basis 23.67 per cent crude protein (C.P.), 14.97 per cent ether extract (E.E.) and 57.91 per cent total carbohydrates (T.C.). Like other concentrates, it is poor in calcium and fairly rich in phosphorus. When fed with wheat *bhusa* the metabolism trial in adult Kumaun bullocks showed that the digestibility co-efficient values of C.P., E.E. and T.C. in maize cake were 84, 79 and 60, respectively. Based on these values, the digestible nutrients per 100 lb. of the cake on dry basis worked out at 19.88 lb. digestible crude protein and 81.39 lb. total digestible nutrients. In digestible proximate principles, maize cake closely resembles coconut cake. It is, however inferior, particularly in protein, to commonly available oil cakes like ground-nut, *til*, sarson, rape and linseed.

63. Utilization of by-products of starch manufacture from maize as cattle feeds : Part II. The nutritive value of maize husk.

D. G. PANDITTESKERE, S. C. RAY and N. D. KEHAR, Izatnagar.

The source of the husk was the same as that of the cake. The sample contained on dry basis 8.12 per cent crude protein (C.P.), 1.52 per cent ether extract (E.E.), 15.67 per cent crude fibre (C.F.) and 88.17 per cent total carbohydrates (T.C.). Its calcium content is comparable to that of an ordinary roughage. In phosphorus however, the husk was extremely poor; but for this essential mineral, on chemical make up it could be considered as good as a cereal grain, such as oats.

In the feeding trial with adult hill bulls, the husk was given as much as the animals would willingly consume. The quantity at which they eventually stabilised was on an average about 1 lb. per 100 lb. live weight. The rest of the ration was made up with wheat *bhusa*. The metabolism trial carried out on the above ration showed that the digestibility co-efficient values of C.P., E.E. and T.C. in maize husk were 47, 26 and 72, respectively. In spite of the ingestion of adequate digestible protein, the animals exhibited significant negative balances for nitrogen, calcium and phosphorus. This negative balance could be ascribed due to phosphorus deficiency induced by phosphorus-poor maize husk which supplied about 67 per cent of the dry matter in the ration.

The investigation has thus shown that any large scale use of maize husk as a stock feed demands caution unless the ration is suitably corrected against the possible phosphorus deficiency. Further work on this line is in progress.

64. Iizuka's test for fluorosis in bovines in the endemic fluorosis area in the Madras Presidency.

G. R. VISWANATHAN, Madras.

The test is harmless and can easily be performed. It can be periodically applied to all cattle in a herd for the purpose of picking out those animals which may need treatment especially with calcium, and thus arrest further progress of the disease. It can also be used to determine whether or not a cure has been obtained. This can be used as a routine method of diagnosing incipient and positive cases of fluorosis.

If the latent and early cases are detected, the use of bonemeal, churn flour or dicalcium phosphate can be administered to compensate the calcium imbalance set up by fluorine.

65. Studies in rinderpest transmission.

B. C. BASU, Izatnagar.

A series of experiments were conducted in connection with the possibility of arthropod transmission of the virus of rinderpest—the most important of all the cattle diseases in India.

*Musca (domestica and nebulosa)*—A large number of house flies in different batches were half-fed on the nostril, eye, rectum and abraded surface of hill bulls infected with rinderpest (at the height of infection as well as when the temperature just came down)



## SECTION OF AGRICULTURAL SCIENCES

PRESIDENT : N. L. DUTT, M. Sc., F. A. Sc.

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### Agricultural Chemistry and Soils

#### 1. Evaluation of natural waters for irrigation : Part II. A semi-micro method of analysis.

C. C. SHAH, Baroda.

The ordinary routine examination of water takes a long time. It is not necessary for agricultural purposes to carry out the analysis in such great details. A method of examination has been evolved and it has been possible to determine (i) the total solids, (ii) chloride, (iii) carbonate, (iv) bicarbonate, (v) sulphate, (vi) nitrate, (vii) calcium and (viii) magnesium, in a sample of water in less than half an hour. The time required per sample is much less if a large number of samples are to be examined. The quantity of water required for an analysis is 100 c.c. and the complete analytical equipment can be carried in a small box for field study.

#### 2. Evaluation of natural waters for irrigation : Part III. Salt content of the well waters in Central Gujarat.

C. C. SHAH, Baroda.

The results of analysis of the salt contents of 46 wells in Central Gujarat have been given. The salt content of the waters from different wells is very variable. The total soluble salts vary from 50 to 800 parts per 100,000. The peculiarity of the waters from this area is that many of them contain a high proportion of nitrate. Waters containing 72 parts of potassium nitrate are known to exist. It is suggested that in such waters, mere high content of total salts should not be the criteria of suitability. A better indication would be the ratio of potassium nitrate to total salts multiplied by 100. It varies from 0 to 20 in these waters.

#### 3. Studies in the surface soil character in North Bihar.—Relation between mechanical aggregates and chemical constituents and their extent of variation.

K. L. KHANNA, S. N. PRASAD, P. B. BHATTACHARYYA and S. D. SINHA, Pusa.

A reconnaissance survey of the surface soils of North Bihar has been done with a view to find the extent of variations of the nutrients N, P, K, Ca and factors like pH, sol. salts, organic carbon, and mechanical aggregates.

It has been possible with the help of this survey to define tentatively the terms used by the cultivators in the locality, in connection with their indigenous soil classification on textural basis. There are altogether ten types recognised by the cultivators, four of which are main types such as Chaur, Banger, Bhith, and Baldhus and others are sub-types. These have been described in detail in terms of their physical and chemical constituents in this paper. With a view to have a rough assessment of the nutrients in the various soil types based on the physical texture, the analytical data accruing from the survey was utilised in finding out correlation between the constituents N, P, and K with the soils classed under different categories. Nitrogen appeared to be associated more with clayey soils compared to either silty or sandy soils on account largely of its presence in humus, a component of the clay complex. Phosphates were associated equally with clay and silt and potassium with silt. It is possible to have high phosphates in both clayey and silty soil because this element seems to be fixed by absorption with clay complex as also the finer particles like silt. Highly clayey soil may remain impoverished in potassium on account of their displacement from the absorbing complex.

## Dairy Chemistry

### 4. A study of cow and buffalo milk.

K. M. MEHTA, Jodhpur.

An examination of the composition of cow and buffalo milk in different parts of Jodhpur State reveals wide variations in composition. The fat percentage and total solids percentage vary from 2.0-6.9 and from 8.5-15.8 in the case of cow's milk and from 3.7-12.0 and 11-18 in the case of buffalo milk. For dry areas like Rajputana the regional variations are marked while the seasonal variations are negligible. It suggests different grading standards for different regions.

### 5. Physical and chemical constants of cow and buffalo ghee.

K. M. MEHTA, Jodhpur.

The physical and chemical constants of cow and buffalo ghee are affected by seasonal and regional factors. The B. R. Values range from 42-45.5 and 41-45; R. M. Value from 18-37 and 16.6-31; and P. Value from 0.5-2.5 and 0.8-2.5 for cow and buffalo respectively. The results clearly show that for regions like Jodhpur State the "Agmark" specifications need modifications.

### 6. Studies in fat globules in milk on souring.

K. S. RANGAPPA and B. N. BANNERJEE, Bangalore.

The physical changes and electro-phoretic velocity of fat globules in milk at different levels of acidity developed on souring in the indigenous curd process have been studied. The evenly distributed fat globules begin to clump together at about 0.2 per cent. acidity, the process being complete at 1.0 to 1.2 per cent., when the fat globules appear enmeshed in the lumps of curdled casein. Churning collects them all into butter except globules below  $3\ \mu$  in size which remain enmeshed in casein.

The anodic movement of milk fat globules steadily decreases with the fall in pH 4.7 to 4.6, nearly all the globules are neutral. The iso-electric point with respect to acidity, however, varies with the type of starter culture (seed curd) used. With a pure culture of *Lactobacillus acidophilus*, the iso-electric point lay between 1.2 and 1.3 per cent. acidity of the curd, but with a mixed starter it lay between 1.5 and 1.6 per cent. There is no difference due to temperature of souring.

## Agronomy

### 7. Economic aspect of ratooning in sugarcane cultivation.

S. B. SINGH and D. S. NAGAR, Shahjahanpur.

A comprehensive experiment to ascertain whether ratooning of sugarcane is a justifiable practice was started in 1939 at Kalai Farm (Aligarh). Costs and returns of plant cane, ratoons and rotational crops were maintained.

The data show that first year manured ratoon yielded on an average 7.5 per cent. less than plant cane. The second and third manured ratoons gave respectively 20.40 and 28.30 per cent. less yield than the plant cane. The extra expenditure incurred in plant cane over manured ratoons was Rs. 103.3 which was not fully compensated by increased yield as compared to first year ratoon. A first year ratoon under manured and well cultivated conditions is desirable.

Unmanured ratoons gave on an average 62.5 per cent. less yield than plant cane. The loss in yield of unmanured ratoons is so large that it cannot be compensated by considerations of cheap production. Manuring ratoons at the rate of 100 lbs. N per acre increased their yield by 120 per cent. and the net financial returns were 215 per cent. above the extra investment in manures.

Ratoons gave better sucrose and purity values than plant cane during the early part of the season.

As regards susceptibility to various pests, it has been observed that ratoons, specially old and unmanured, are highly susceptible to white fly attack, while plant cane is highly susceptible to termites and pyrilla attack. Borers and pyrilla generally infest ratoons first and then migrate to plant cane at a later stage.

## Section 10 : Agricultural Sciences

### 8. Nitrogen availability of green-manures under field conditions.

R. C. SHRIVASTAV, Nagpur.

Rate of decomposition and nitrogen-availability under field-conditions are described for four green-manuring plants. The experiment was on a black cotton soil field and the plants selected as manures were Sann (*Crotalaria juncea*) grown separately for the purpose and Tarota (*Cassia tora*), Shevra (*Alisicarpus rugosus*) and Dhaincha (*Sesbania aculeata*) collected as weeds. The manures were ploughed in about the middle of August. As in laboratory experiments, measurable amounts of nitrates were formed during a fortnight of the incorporation of the green-material. The nitrates predominated in the top 6" layer and exceeded those of the controls by a maximum of 4.5 p.p.m. at the end of four fortnights corresponding to a nitrification of 11.4 p.c. This figure is considerably lower than that recorded under laboratory conditions. The nitrates were kept at a high level for the period middle of October to January which coincides with the actively-growing period of the winter crops. The plants showed slight variations in their capacity to nitrify, being in the following descending order :—Shevra > Sann > Dhaincha > Tarota.

### 9. Chemical composition of some common winter crops as affected by progressive maturity.

N. D. KEHAR and I. P. AGRAWALA, Izatnagar.

While evaluating different livestock feeds it was observed that most of the data on the chemical composition of some common plants at different stages of growth was lacking. In order to provide this information, 4-weekly analysis of wheat (*Triticum vulgare*), gram (*Cicer arietinum*), barley (*Hordeum vulgare*), peas (*Pisum sativa*), Sarson (*Sesamum indicum*), Alsli (*Linum usitatissimum*), Masoor (*Ervum lens*) and Khesari (*Lathyrus sativus*) was undertaken from the time of sowing till the plant was dead ripe. Along with these, weeds, namely, *Piazi*, *Bathwa* and *radish* leaves, were also analysed. The analysis consisted of the following constituents :—Crude protein, ether extract, nitrogen-free-extract, total carbohydrates, calcium and phosphorus.

It was found that the protein content of almost all the above plants decreased with progressive maturity of the plant. In certain cases the decrease was more than sixty per cent. The calcium content also decreased with progressive maturity except peas (*Pisum sativa*). The decrease in the case of *Piazi* also was not very appreciable whereas in the case of *Bathwa* calcium increased with progressive maturity.

The phosphorus content of these plants does not seem to be materially affected by progressive maturity.

The above samples were taken from an irrigated village. Representative samples were also collected from an adjoining unirrigated village under identical conditions for comparing their chemical composition.

### 10. Mushroom culture on the banks of fish ponds.

T. J. JOB and (Miss) F. THIVY, Madras Fisheries.

A gently sloping, shallow, wet bank at least on one side is found to be highly advantageous in the fish pond, and the addition of leaf mould and farm-yard manure is a regular routine in pisciculture. These provide favourable environments for mushroom culture as well. Field experiments conducted at "Fishlands," Madras, on the edible *Agaricaceae*, *Marasmius oreades* (Bolt.) Fr., *Lepiota cepaestipes* (Sow.) Fr., *Hygrophorus* sp., *Volvaria diplasia*, Ehrenb., *Pluteus cervinus* (Schaeff.) Fr., *Leptonia* sp., *Psalliota* spp., *Hypholoma appendiculata* (Bull.) Fr. and *Coprinus* spp., show the possibilities of raising profitable mushroom crops as a subsidiary yield from fish farms. The systematics and bionomics of these species are detailed elsewhere by one of us (Thivy, 1946).

With more than seven per cent. of proteins and appreciable proportions of carbohydrates, fats and valuable salts, the mushroom tops the vegetables in food value. The edibility and flavour of the esculent species have been determined. The fear of poisoning is considerably allayed by the exposition of the low percentage of poisonous species and their warning characters.

Cured cowdung, leaf moulds of *Enterolobium saman*, hay, felled plantain trees and vegetable parings are among the manures tried. The optimum external and internal temperature and humidity ranges for successful culture of the species are worked out.

The economics of mushrooms in aquacum-agriculture are mentioned. A periodic progression in the laying of the manure bed under an inexpensive fish shade extending to the bank, a primary and a secondary harvesting of the mushroom crop and the aquatic manuring by the spent bed is expounded.

# 11. On the alleged toxicity of the stagnant silt in old tanks.

(Miss) FRANCESCA THIVY, Madras.

Desilting of tanks which is an accepted routine in pisciculture is often an expensive and difficult operation. Phytocultural experiments were conducted with samples of the bottom mud of the Attigunta tank, Nellore District. Chemical analysis had shown the absence of nitrates, presence of humus, phosphates and ferrous sulphide. No hydrogen sulphide was found to be evolved from the silt.

Algae from nutrient cultures were transferred to distilled water in jars containing a bottom layer of the silt. The pH of these silt cultures was favourable to the growth of the algal species introduced, yet the latter died, sooner or later. *Aphanocapsa* survived longer than *Spirogyra*, and the latter longer than *Closterium*. *Chara oospores* germinated, evidently nourished by food reserves. It is probable that the ammoniacal nitrogen resulting from the breaking down of humus served to bring about the growth of the algae, but that it was insufficient for normal growth.

In control experiments introduction of the silt into cultures of algae in nutrient solutions failed to produce deleterious effects.

In the light of these findings the alleged toxicity of the stagnant silt in tanks has necessarily to be re-examined.

# 12. Study on the ascorbic acid content of common fruits and vegetables of Gujarat : Part III. Effect of fertilizers on Vitamin C contents of some vegetables.

K. G. NAIK, C. C. SHAH and H. G. PANDYA, Baroda.

Various factors have been reported in literature to affect Vitamin C formation in plants. It is both interesting and useful specially from the particular viewpoint of the quality of crop to ascertain how Vitamin C contents can be favourably influenced by subjecting the soil to some suitable treatment particularly with specific fertilizers. It has been found that the application of (1) nitrogenous fertilizer is conducive towards the development of ascorbic acid; (2) phosphatic fertilizer has very little effect on Vitamin C contents; (3) potassium fertilizers tend to slightly decrease Vitamin C contents of the plants. A complete fertilizer composed of nitrogenous, phosphatic and potash manures, shows practically the same or a negligible increase of Vitamin C content, as compared to the control.

Generalisation regarding the effect of fertilizer is really difficult as it is not easy in such experiments to provide effective and adequate control and draw clear-cut deductions. Nevertheless, the above data are of value in indicating certain probabilities.

# 13. Effect of irrigation on Summer Bajri (*Pennisetum typhoidum*).

C. C. SHAH, H. M. PATEL and M. S. GHAREKHAN, Baroda.

Bajri was sown on 21st February, 1946, and harvested on 7th May, 1946. The results obtained show that for maximum yields, the crop should be irrigated every alternate day. Nitrogenous fertilizer alone has no effect, it reduces the yield per plant from 4.56 to 4.27 gms. The grains are however larger. The weight of 1,000 grains being 6.14 gms., as compared to 5.74 in the control. Application of nitrogen and phosphate, the first at planting time and the latter at flowering time, increases the yield to 5.32 gms. per plant and the grains weight to 6.63 gms. Application of nitrogen at a later date does not improve the yield.

# 14. Studies in storage of Gur ; Part I.

K. L. KHANNA and A. S. CHAKRAVARTI, Pusa, Bihar.

Under the highly humid conditions prevailing in the eastern tracts of India during the monsoons, storage of gur at this time of the year presents a serious problem as the material is apt to suffer greatly in quality as well as quantity on account of moisture absorption, resulting in inversion and fermentation which give rise to great deterioration

and loss. The country methods of storage in vogue (*e.g.*, inside a blanket of *bhusa* or wheat and straw) give far from satisfactory results and in these days of acute food shortage, the need for evolving an effective storage method must be regarded as a national one.

These studies were, therefore, undertaken with the twofold objective of (1) devising an effective method of *gur* storage capable of saving it from the ravages of the monsoons and (2) studying the nature of variations in physical and chemical attributes of *gur* under different storage conditions, ascertaining at the same time the characteristics in respect of these properties associated with different stages of deterioration. Two blankets, *viz.*, furnace ash (from *gur* furnace) and powdered charcoal (selected respectively on account of their hygroscopic and absorptive properties), were studied with regard to their efficacy as storage blanket in relation to the country method of storage in *bhusa* and storage under exposed conditions. The ash blanket showed outstanding results in that it saved *gur* from the least deterioration in the rains, obviously on account of its hygroscopic character by virtue of which the moisture is arrested in the body of this material, thus finding no access to the product stored inside. The ash adhering to the *gur* is easily removed by a superficial dusting and the method must therefore be regarded as a commendable one.

Periodic examination of changes in quantitative physical and chemical properties—sucrose, glucose, moisture, acidity, colour intensity, suspended impurities, pore space, show marked differences in behaviour under different storage conditions which lead to the formation of definite characteristics in respect of these properties associated with different stages of deterioration.

## 15. Sampling studies in sugarcane : Part I—The estimation of fibre.

K. L. KHANNA and S. C. SEN, Pusa, Bihar.

The direct method of fibre determination is both laborious and time-consuming, besides requiring frequent changes of the calico bags employed for the washing of cane pulp and on that account is difficult to adopt where large rounds of analysis have to be completed during the course of the day. Further the variations in the values obtained in different quality calico bags vitiate the results. A recourse has, therefore, to be had to an indirect method where the results of fibre content would agree closely with those obtained by the use of the standard direct method. Such has actually been the case in Deerr's indirect method of fibre determination, in the work reported in the paper.

Largest variations have occurred in the cane stalk and as such composite sampling in respect of different portions of cane stalk and a whole clump as a sampling unit have resulted in a sampling technique for fibre that ensures valid results.

The procedure ultimately standardised for adoption is as follows :—

Collect randomised six whole-clumps in the early part of the crushing season and randomised three whole-clumps in the latter part, taken at different points in a plot of 1/40th acre field. Strip the stalks properly removing attached root, etc., and divide each cane into three equal portions, (1) top, (2) middle and (3) bottom. Shred one complete nodal length at two ends of each divided section, preferably in an electric shredder, covered all round; the shredded pulp is mixed thoroughly and 100 grammes are immediately weighed in a tared tray and dried to a constant weight at 100–105°C for moisture per cent pulp, cane portions left after shredding are crushed in a hand or bullock mill and brix of the extracted juice recorded and corrected at 20°C. Fibre per cent. is then calculated by Deerr's formula given below :

$$\text{Fibre per cent. Cane} = 100 - \frac{100 \times \text{moisture per cent. pulp.}}{100 - \text{Brix extracted juice.}}$$

## 16. Foliar diagnosis as an index of optimum fertilization for sugarcane in calcareous soils.

K. L. KHANNA, S. N. PRASAD and S. D. SINHA, Pusa.

Various workers have suggested analysis of different plant parts, *viz.*, whole plant, its expressed sap, standard leaf or alcoholic extract of the standard leaf to serve as an index of manurial needs of these crop plants. Preliminary studies made at the station showed that both the standard leaf as also the alcoholic extract in cold of the standard leaf termed as "crude chlorophyll" gave better results compared to the whole plant in assessing nutrient requirements. This was particularly so in the case of phosphates where high phosphate treatments gave evidence of high phosphate uptake by



plants. Maximum recovery of nitrogen in the leaves was in May while that of the phosphates in August. In the case of inorganic phosphates reverse was however the case.

This suggested the possibility of their conversion into the organic form at the time of high metabolic activity of the plant. Further work on the phosphate and nitrogen assimilation and metabolism is in progress.

## 17. Effect of soil conditions on the growth and the chemical composition of sugarcane.

N. L. DUTT and K. V. G. AIYER, Coimbatore.

Though the climate is the dominant factor affecting the growth and composition of sugarcane, soil and other environmental conditions including agricultural practices have their own effect. At the Imperial Sugarcane Station, the growth of the cane varieties, as also the chemical composition of the juice in the Garden land plots have been found to be different from those in the Wet land plots, though these may be almost adjacent to each other. The main differences in the 'Garden land' and the 'Wet lands' consist in their soil texture and method of cultivation. The Wet lands are slightly more clayey and are used for paddy cultivation involving puddling and flood irrigation from canals and tanks, while the Garden lands are irrigated from wells and used for crops other than paddy.

Seven commercial standard varieties, one *Sorghum* hybrid, and one bamboo hybrid were included in these studies. In the matter of growth and yield per row, the canes in the Garden land were in almost all cases superior to those in the Wet lands. It was noticed that not only the individual canes were heavier in Garden land, but the number of canes per row was also generally more.

As regards juice quality the canes in the Wet lands were in all cases and also throughout the crushing season superior to those in Garden lands. It was found that not only the maturity was attained earlier in the Wet lands, but also the maximum C.C.S. per cent. was more in all the varieties.

Taking the total C.C.S. per row, which combines both tonnage and juice quality, it was found that in many cases, *viz.*, Co.419 and P.O.J.2878, the better juice quality in Wet lands more than made up the deficit in tonnage.

It was found that canes in the Wet lands flowered more profusely than those in the Garden lands and this reflected itself in the relatively higher percentage of fibre in the Wet land canes. Total nitrogen content in the juice was generally noticed to be less in Wet lands than in Garden lands. There were also slight differences with regards to other constituents in the juice, as ash, CaO, K<sub>2</sub>O and Fe<sub>2</sub>O<sub>3</sub> though they were neither consistent nor significant.

As the soil analysis does not reveal much differences between Wet lands and Garden lands, it is presumed that the great differences in growth and composition noticed might be to a great extent due to the differences in the moisture relations and texture of the soil in both the plots.

## Agricultural Botany

### 18. Some aspects of the problem of evolution of strains for crop improvement.

N. PARTHASARATHY, Coimbatore.

Evolution of superior pure lines from a bulk population or progenies raised by hybridisation is the main line of work followed by crop specialists for crop improvement through breeding. In any system of crop culture, it is important to realise that environment including agricultural conditions, is not static and may even vary from year to year in any particular tract. For any such dynamic environment, it is now increasingly felt that the system of evolving a superior pure line—a fixed and rigid genotype—after arduous methods of breeding, extending to over 8 to 10 years may not after all be a useful procedure.

There is no doubt that natural selection is a potential but an unseen and imperfectly understood directive force, which acts though slowly, on a variable population and the resulting fittest population is never a homozygous type, but is a combination of several genotypes. How far the breeder can take advantage of this force and not only aid but also hasten natural selection by devising suitable modifications in the breeding methods are discussed.

## 19. Suggested standard for botanical description and identification of sugarcane varieties.

N. L. DUTT, M. K. KRISHNASWAMI and J. THULJARAM RAO, Coimbatore.

A morphological descriptive study of sugarcane varieties often offers difficulties due to the large number of characters available of which only a few are reliable. Variation of characters is common in the different canes of a variety and even in the same cane. Descriptions of cane varieties have to suit the layman since the ordinary cultivator should be able to differentiate the varieties he is growing. It is essential to prescribe a few definite characters of value for each variety and also to fix up particular place or places in the cane for examination of these characters. The study of the large number of sugarcane varieties has given an indication of the variability of characters and those on which reliance can be placed. More important of the characters are: (1) the colour of the basal internodes after exposure, (2) the presence and amount of bloom, (3) the presence of growth cracks, (4) the presence of bud grooves, (5) the nature of ligule, (6) the nature of auricle, (7) the presence of bloom and hairiness of sheath, (8) the size, shape and origin of bud, and (9) the size of leaf under conditions prevailing in a particular locality.

The top most dry leaf joint has been found to be the best for study of internode and bud. For ligule and auricle the third topmost fully unfurled leaf has been judged to be the best.

## 20. The relation between anatomical and morphological characters and resistance to drought in sugarcane varieties.

N. L. DUTT and J. THULJARAM RAO, Coimbatore.

The ability of the sugarcane crop to withstand drought is of importance in its economic production and is one of the major problems in the development of improved varieties. One of the programmes of work at the Sugarcane Breeding Station has been to breed canes resistant to drought.

The different species and varieties of *Saccharum* differ in their resistance to this factor. While the varieties of the cultivated species *S. officinarum* are susceptible, those of the wild cane *S. spontaneum* are noted for their resistance. Certain of the hybrids produced at the Station have been found to be satisfactory in this respect.

The root system and internal structure of the root, stem and leaf of representative varieties from the different species of *Saccharum* and certain hybrids—all known for their reaction for drought—were studied.

It has been found that as compared to the susceptible ones, the resistant varieties are characterised in general by (1) a deeper root system with more of roots and lateral spread, (2) more of conducting vessels in the root and stem, (3) more of sclerenchymatous tissue in the stem, (4) thicker cuticle in leaf epidermis, (5) smaller number of stomata per unit area of leaf, (6) smaller stomata, (7) sunken stomata, (8) greater number of bulliform cells and (9) smaller area of leaf surface.

The resistant varieties are thus adapted efficiently for securing more water and minimising transpiration to a great extent rendering themselves capable of withstanding drought. The present results indicate that a possible index may be based on the above characters. The criteria are proposed to be utilised for selecting seedlings for the sub-tropical tracts.

## Agricultural Pests and diseases

### 21. Studies on the control of sugarcane borers by *Trichogramma minutum*, Riley.

K. L. KHANNA and L. N. NIGAM, Pusa, Bihar.

The paper deals with an account of field trials of the egg parasite—*Trichogramma minutum* Riley, as means of controlling the damage to sugarcane plant caused by the stem borers: *Argyria sticticarpis* and *Diatraea auricilia* and root borer *Emmalocera depressella*. The efficacy of the parasite has been tested by estimating the reduction in the incidence and population of these borers in the crop in which it has been released, by estimating the increase in the extent of parasitization of the stem and root borer eggs, and the appreciation in the yields of the fields brought about as a result of the colonisation of

the parasite. The studies have been conducted in critically laid out experimental plots in the factory estates of Champaran and Muzaffarpur districts during the last three seasons (1943-44 to 1945-46). The results have shown that the incidence and population of stem borers and root borer and "deadheart" caused by them were significantly lower and the extent of parasitization of the eggs considerably higher in the colonised plots. In view of the fact that the stem borer *Argyria sticticraspis*, which causes serious damage in the young crop during the early part of the crop season, is followed by another species *Diatraea auricilia* which continues the damage in the grown up canes in the later part of the crop season also, and that the root borer *Emmalocera depressella* continues its damage in varying degrees throughout the crop season, it has been found more useful to carry on the releases of the parasite continuously, without any interruption, throughout the active period of the borer larval (April to October). The activity of the parasite has been found greatly influenced by the prevailing weather conditions and it has been suggested to release the parasites in larger population to compensate for any adverse effects of the weather. The yields of the colonised plots have been found to be appreciably higher thus bringing out clearly the beneficial effects of the parasite.

## 22. Variations in *Colletotrichum falcatum*, Went.

S. A. RAFAY and S. Y. PADMANABHAN, Pusa, Bihar.

*Colletotrichum falcatum*, Went cultured on oatmeal agar at 30°C exhibited variation. The parent culture was light gray turning dark gray. The texture was not compact and velvety but buckled into cottony knots. Together with scanty sporulation in pink masses soft black round bodies 0.1—0.5 m.m. in diameter were observed. In one of the variants two narrow sectors developed. The fungi in the sectors were light coloured with loose-texture. In the other variant a patch developed with white cottony mycelium raised above the original surrounding tissues. In another culture which was dark gray, compact cottony and rarely sporulating an interesting variant developed with extremely abundant spores with no appreciable mycelium. The cultures described above have retained their identities.

In the light race also variation was observed. The variant in this case differed from the parent in developing darker colour and less loose texture. There were no spore masses visible.

The first two variants described above show that the lighter race of red rot parasite described in Bihar as being responsible for the epidemic has probably arisen by a sudden inherent change.

## Crop Physiology

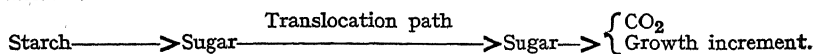
### 23. A study of the effect of temperature on the respiratory activity and development of germinating barley seedlings—the behavior of respiratory activity at different temperatures.

N. D. YUSUF, Coimbatore.

In a germinating seedling, with a limited amount of stored food, the two carbohydrate functions—growth and respiration—are greatly influenced by each other, the intensity of one depends largely on the intensity of the other, and this factor becomes more effective with the depletion of the stored food. The process of growth seems to affect the respiration rate in two ways, firstly, by increasing the number of respiratory centres and secondly, by utilising a definite part of the stored carbohydrates for the formation of new tissue, which with the exhaustion of endosperm probably tends to depress the respiratory activity by tending to lower the concentration of sugars at the respiratory centres.

The rate of both the processes in which carbohydrate is used, *viz.*, growth and respiration, is dependent on the rate of supply from the endosperm which is in turn determined by the rate of hydrolysis in the endosperm and the rate of translocation of the products of hydrolysis to the actively growing regions.

A simple picture of the metabolic functions of germinating seedline may be summed up as follows:—



To see how far the linkage of the various functions of carbon metabolism is influenced by temperature, an investigation was made of the drift of respiration rate of barley seedlings kept continuously at temperatures 7°, 12°, 17°, 22°, 27°, 32° and 37° C., using 22°C. as the standard temperature.

The time curve for the respiration rate of the whole seedling at 22°C., *i.e.*, the standard temperature, showed three well defined phases, : (1) the rising respiration rate (2) the constant respiration rate and (3) the falling respiration rate. The drift of respiration at temperatures 7° to 27°C. was similar to that at 22°C., *i.e.*, the same three phases were distinguished. The differences were noticed only in the time relations and level of respiration rate. The increase in temperature increased the initial and subsequent rate during the rising portion, pushed up the maximum, shortened the constant phase and led to a more rapid decline.

At 32°C. the respiration time curve did not confirm to the usual form. The rising respiration phase was depressed, it did not attain the maximum expected for the corresponding rise in temperature, and the constant phase was prolonged.

At 37°C., there was no germination, the respiration rate rose to a low maximum and then became constant.

As an attempt at analysis of the effect of temperature on time relations of the respiration drifts, the drifts as observed at different temperatures are set out against total carbon dioxide. It is to be noted that if the linkage of respiration rate with growth is true also for the development of respiratory centres then at different temperatures the same total amount of CO<sub>2</sub> produced might represent a similar stage of development, *i.e.*, the total CO<sub>2</sub> at any time may be taken as an approximate measure of the metabolic age of the seedling; and the rates at different temperatures thus plotted against total CO<sub>2</sub> may be considered as representing the more immediate effect of temperature on respiratory activity as apart from its effect on development.

It was found that the curves for temperatures 7°-22°C. correspond closely in phase. The ratios of the respiration rates (as set out against total CO<sub>2</sub>) at any one temperature to the rates at 22°C. remained approximately constant throughout the drift. At 27°C. the relations of respiration rate to total CO<sub>2</sub> produced were not the same as at 7°-22°C. Maximum was delayed and the fall in the rate was less rapid. Evidence is presented that at this temperature the growth-respiration relations are disturbed, growth is inhibited so that the diminished utilization of carbohydrates for dry weight increase of embryo leaves more available for respiratory activity and hence delays the fall in the respiration rate.

The effect observed at 27°C. is still more accentuated at 32°C.

## 24. Some studies on low temperature resistance in sugarcane.

N. L. DUTT and M. VIJAYASARADHY, Coimbatore.

Injury due to frost and low temperature on sugarcane crop has been known for a long time. The development of cold resistant cane varieties is an important problem in sugarcane breeding. Investigations on the low temperature effects on sugarcane setts and sett plants had been carried and results of considerable interest were obtained.

Single eye setts of 36 cane varieties were subjected to cold temperature of 3° to 5°C. for 5 days and their subsequent germination behaviour studied. It was found that low temperature had a depressing effect on germination and that different cane varieties showed different degrees of susceptibility. The wild spontaneums were found particularly susceptible in this respect.

Six to eight weeks old sett plants of 21 cane varieties were given a 5-day cold treatment of 3° to 5°C. and allowed to grow under normal conditions. It was observed that different varieties exhibited different degrees of resistance and nature of injury. Here again the spontaneous showed the greatest injury.

The inherent resistant quality of a variety is considered to be seen best under low temperatures and this quality is associated with certain changes in the sap and in the protoplasm. The change in Osmotic concentration of the sap, developed in the tissues of 20 cane varieties after 12, 24, 48, 72, 96, 108 and 120 hours cold treatment was determined plasmolytically using CaCl<sub>2</sub> as the plasmolysing agent and neutral red as the stain for determining the incipient plasmolysis.

Though no characteristic difference was noticed in sap concentration under ordinary conditions in different varieties tested, the varieties showed marked changes in Osmotic concentration under low temperature. This change in Osmotic concentration was employed in distinguishing resistant, moderately resistant and susceptible cane varieties.

The extent of Osmotic concentration variation was different in different varieties. This ranged from 0.03 M to 0.15 M. The varieties (*viz.*, Co.281, Co.290, Co.453 and Co.605) showing variation from 0.12 M to 0.15 M were considered cold resistant; the varieties (*viz.*, Co.205, Co.214, Co.285, Co.312, Co.637 and Katha) with a variation between 0.07 M to 0.11 M as moderately resistant and the others (*viz.*, Co.421, Co.313, Co.617, Co.634, Co.635, Co.636, *S. spontaneum Tank* and *S. spontaneum Glagah*) showing variation of 0.03 M to 0.06 M were considered to be non-resistant.

## 25. On the viability of sugarcane seed.

N. L. DUTT, M. VIJAYASARADHY and K. S. SUBBA RAO, Coimbatore.

Sugarcane seed has been found to lose rapidly its germinating capacity under ordinary conditions within a month sometimes even in a few days.

The seed of Co.419 and P.O.J.2878, when preserved in (1) paper packets, (2) airtight tins, (3) sealed tins with CO<sub>2</sub>, (4) sealed tins with CO<sub>2</sub> plus CaCl<sub>2</sub>, and tested for germination fortnightly for 105 days showed that the seed stored under the conditions of 3 and 4 gave high level of germination and retained viability for a longer period than that stored in paper packets which was found to have lost its viability almost completely within about a month.

Air dried seed of 10 varietal crosses which was stored during 1939-40 season in sealed tins under CO<sub>2</sub> and CaCl<sub>2</sub>, when tested for viability yearly for 4 years showed that especially the seed of wild spontaneums and improved canes, *viz.*, Co.419 and Co.421 was found to retain viability even after 4 years.

Chilling the seed after collection at 0°C. for 34 days improved germination capacity and retained seed viability for long periods.

For any studies on germinating sugarcane seed, the seed stored in tins under CO<sub>2</sub> and CaCl<sub>2</sub> would be an ideal material, as such a seed continued to germinate well for more than seven weeks even after the sealed tins were opened, whereas that stored in tins without CO<sub>2</sub> and CaCl<sub>2</sub> was found to lose completely its viability by about the 3rd week after the opening of the tins.

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## SECTION OF PHYSIOLOGY.

PRESIDENT : PROF. S. A. RAHAMAN.

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### Pharmacology

#### 1. Chemotherapy of Surra.

B. C. BASU, Izatnagar and B. MUKERJI, Calcutta.

There is no "specific drug" for the treatment of Surra. Early administration of arsenical and antimonial preparations and more recently "Naganol" (Bayer 205) are reported to give good results in a certain percentage of cases. It is needless to say that "Naganol" proved the best. During the last Great War "Naganol," being a German preparation, was not available in this country. "Antripol"—a British product of similar chemical composition to "Naganol"—was extensively used both in the Military as well as Civil departments during the war period. Veterinary Officers with the British Army in India have reported reasonably satisfactory results with the use of "Antripol" in the treatment of Surra.

Collaborative work between the Imperial Veterinary Research Institute and the Biological Standardization Laboratory, Government of India, Calcutta, was established to test the chemotherapeutic value of various drugs (Indian as well as foreign manufacture) against Surra. So far, five drugs have been tested for this purpose. They are Anthiomaline, Stilbadimine (M.B. 744), Urea Stibamine, and two arsenical compounds of the arsenoxide type (Nos. 1 and 2). Effects of these drugs were tested on guineapigs (generally 450-550 grams) infected with *Trypanosoma evansi*, the causative organism of Surra. Every experiment was compared with control ones.

*Anthiomaline* was not found suitable as it could not stop the appearance of the trypanosomes in peripheral blood of guineapigs nor could it stop the death of the animals. A single dose of 0.1 c.c. and 0.2 c.c. was tested.

With a single dose of 0.1 gram of *Stilbadimine*, Trypanosomes disappeared from the peripheral circulation and the parasites did not survive in the spleen in the negative phase. This was tested by inoculating spleen emulsion of the guineapigs in negative phase into healthy guineapigs.

With a single dose of 0.05 gram of *Urea stibamine*, trypanosomes disappeared from peripheral blood but this dose was found lethal for guineapigs.

With the administration of two new arsenical compounds (Nos. 1 and 2), trypanosomes did not disappear from peripheral blood but the guineapigs survived upto four months or longer. This shows that the trypanosomes are in chronic condition and that the pathogenicity in the treated animals is lost. Such trypanosomes, when passaged to healthy guineapigs, proved quite pathogenic.

The work is in progress and this report is of a preliminary character.

#### 2. Deterioration of Insulin in the Tropics.

N. K. IYENGAR and B. MUKERJI, Calcutta.

Since Insulin is a biological product of protein nature, the B.P. as well as the U.S.P. have recommended that it should be kept in refrigerator above freezing and below 59°F. Kept under these conditions, Insulin has been known to maintain its potency for 2 years or even more. The authors had the opportunity of testing several samples of Insulin manufactured in different countries. Due to the scarcity of Insulin in war time in India, some time-barred samples were also submitted to this laboratory for test in order to consider the desirability of using them. A large number of samples were found to retain full potency although they were more than 2 years old. Samples of Insulin from one or two reputed manufacturers were found to have either turbidity or even suspended matter, although the Insulin was not yet time-barred. The liquid portion of these samples were found to have been reduced in potency and considerably so in cases where the suspended matter was high. There was no particular reason to suspect that only these samples were not

kept in the refrigerator while the others which were found to be good were kept at low temperatures. The pH of all these samples were also found to be between 3 and 4 as required. The suspended particles from these Insulin samples were filtered off, washed with saline and subsequently dissolved in acid and the resulting opalescent solution was found to have the potency amounting to nearly 70% of the total Insulin in the original vial. The suspended matter is, therefore, largely Insulin which has come out of solution.

If it is assumed that the conditions of storage were the same in both cases, the observed difference in the tendency for Insulin to come out of a solution can be attributed only to the state of purity of the solid Insulin used for preparing these solutions. Both crystalline Insulin and amorphous Insulin of various grades of purity are employed by manufacturers for the preparations of Insulin solutions for injection. Insulin solutions prepared from amorphous Insulin having a potency of 15 to 18 units per mg. have been found to be less stable than corresponding solutions prepared out of crystalline Insulin having a potency of 22 to 24 units per mg. The latter remain perfectly clear and potent even after two years while the former develops turbidity gradually and finally the solid Insulin is thrown out of solution.

### 3. Standardisation of Ouabain by using guineapigs as the test animals.

N. K. DUTTA, Calcutta.

Both the British and the United States Pharmacopæias have adopted a standard Ouabain as the basis for comparing the activity of Strophanthus preparations. The B.P. has established subsidiary standards of Strophanthin (Kombe) and the Tincture made from Strophanthus (Kombe) and their activity have been defined in relation to the International Standard Ouabain. Various species of animals such as dog, cat, guineapig and frog have been recommended as the test animals for the evaluation of the same preparations in terms of the standard Ouabain. Of these guineapig seems to be one of the most suitable species for adoption in this country. Experiments were carried out on thirty adult male guineapigs weighing not less than five hundred grammes each. They were starved for a period of 24 hours before experiments were started. The solutions of International Standard Ouabain used were 0.001 per cent. and 0.002 per cent. in normal saline (first a little alcohol was added to dissolve Ouabain). The solutions were transfused to the guineapigs anaesthetised with arethane (1.8 gm/Kg), through the jugular veins at the rate of 0.5 c.c. per minute till the heart ceased beating. The average total amounts of Ouabain required to bring about the end points were 0.2879 mg/Kg and 0.1308 mg/Kg for 0.001 per cent. and 0.002 per cent. solutions respectively. The errors in both the cases were not more than 1.39 per cent.

### 4. The use of latent period in the assay of pituitary (posterior lobe) powders on isolated guineapig uterus.

N. K. DUTTA and S. BHATTACHARYA, Calcutta.

The present oxytocic method (British Pharmacopæia) of assay of pituitary (posterior lobe) powders is based on the quantitative responses as measured by the heights of contractions of different dilutions of the drug on isolated virgin guineapig uterus. The method is time consuming and often the uterus passes on to the stage of maximum contraction, thereby, the whole experiment is spoilt. The present investigation depends on the fact that the dosages of the pituitary extract (prepared from powder) may be so adjusted (0.00002 I.U. to 0.00004 I.U.) as to produce contraction of isolated (virgin) uterus after an interval of one to five minutes. This latent period, *i.e.*, from the time the drug is administered to the first wave of contraction of the uterus, depends on the strength of the solution used. The latent period is prolonged with lower concentration of the drug. The potencies of a number of pituitary samples (powders as well as extracts) were determined in this way. The results were computed by the application of formulæ given by Voges., J. B. (*J.A.M.A.* 32, 383, 1946). The error, in any assay, was not more than fifteen per cent. The advantage of this method is that the drug may be added to the bath at intervals of seven minutes and fifteen dosages are sufficient to complete an assay.

### 5. Studies on the stability of pituitary extract (post. lobe) and some observations on its physiological standardisation method.

B. CHATTERJI, Calcutta.

The physiological activity of samples of pituitary extract (Post), two to seven years old, has been estimated according to the standard method and the effect of aging has been determined.

Some modifications of the standardisation method have also been suggested.

## 6. Action of decholin (sodium dehydrocholate).

H. K. BISWAS, T. HOSSAIN and N. K. IYENGAR, Calcutta.

Geiger *et al* (*J. Amr. Phar. A.* 35, 75, 1946) have found that sodium dehydrocholate when intravenously injected to rabbits in doses of 350 to 500 mgs. per kg., produces hypothermia and also significant hyperglycæmia. Various doses of sodium dehydrocholate were intravenously injected to rabbits. Significant hyperglycæmia at the end of 1 hr. was noticed when the dose was above 300 mgs. Depending on the dose employed, the increase in blood-sugar was between 20 to 30%. At the end of 1 hr. there was a tendency for the decrease of the blood-sugar which came to its original value at the end of 2½ hrs. The mechanism of this hyperglycæmic action in relation to the hypoglycæmic action of Insulin is under investigation.

## 7. Bacteriostatic action of amellin.

M. C. NATH and H. D. BRAHMACHARI, Nagpur and Dacca.

Amellin the antidiabetic principle which has already been reported to heal up wounds and ulcers in diabetic patients on oral administration, has been found to be bacteriostatic in invitro experiments on B-coli and S. Aureus. Retardation in the formation of colony in presence of glucose has been observed at the concentration of 1 in 1,000. Nutrient meat broth with 2% Agar was used as the culture medium.

That amellin is bacteriostatic and not bacteriocidal has been proved by sub-culture.

## 8. Influence of bile salts on the absorption of quinine.

S. MUKHERJEE and U. P. BASU, Calcutta.

An explanation is offered of the mechanism of the absorption of quinine from the intestine on the basis of its interaction with bile salts. Quinine in the form of a solution of its salts, reacts with an excess of sodium dehydrocholate or tauroglycocholate in an alkaline medium to form a colloidal solution. When the latter is subjected to dialysis through collophane, previously swelled with zinc chloride, both quinine and the bile acids are found to diffuse out through the membrane. Quinine dehydrocholate is only partially peptised by an excess of bile salt solution, and the resulting colloid, on dialysis, also behaves in a similar manner. It has been suggested that the presence of bile salts in the intestine help the absorption of quinine by rendering it diffusible and that the administration of a choleric simultaneously with quinine would enhance its absorption.

8a. Study on a new cardiac drug isolated from jute seeds—*Corchorus capsularis*.

N. K. SEN and N. N. DAS, Calcutta.

Indian works on *Materia Medica* describe the leaf of jute plant as a household remedy in several diseases. According to Dymock the seeds, which have a bitter taste, also possess medicinal properties and are administered in doses of 80 grains in cases of fever, obstruction of the abdominal viscera and dysmenorrhea.

One of the present authors, N. K. Sen, thoroughly studied the chemical composition of *Corchorus capsularis* and isolated an extremely bitter glucoside from the jute seeds in crystalline form. The glucoside is considered to be the probable source of the reputed physiological action of the seeds which are used to some extent medicinally in India. The bitter principle of jute seeds isolated by Sen was found to be a colourless substance crystallising in stout rhombic prisms melting at 174-175°C. It had the molecular formula  $C_{22}H_{38}O_8$ : possessed an intensely bitter taste and was named corchorin. (*J. Ind. Chem. Society*, 7, 905 (1930)). The study of the chemical structure of the glucoside corchorin by Sen revealed the presence of  $\beta$ - $\gamma$  unsaturated lactone, the most characteristic pharmacological group of all cardiac poisons belonging to digitalis series. It was found to have no haemolytic action on the red blood corpuscles. The present study was planned to explore the effects of administration of corchorin in frog and cat in order to compare its effects with those of digitalis group and further to compare the response of those animals under similar conditions. Experiments were performed to ascertain the pharmacological action of the drug and its lethal dose.

It was found that very small doses of corchorin in aqueous solution has marked stimulating action of heart, and some action on the blood pressure.

Further work is in progress.



## Biochemistry

### 9. Oxidations carried out by virulent and avirulent strains of plague bacillus.

S. K. GOKHALE, Bombay.

It is known that the oxidation of different substances like carbohydrates, amino acids etc. by bacteria is carried out by the activity of the particular enzyme for the particular substance. Oxidation of certain substances by the plague bacillus using only a virulent strain has been studied before (Rao, *Jour. Ind. Med. Res.* 1940, 27, 617). The object of the present study was to find out—whether the enzymatic properties of the bacterial cell are destroyed or get modified when the organism passes from the virulent to the avirulent state. It is known that the antigenic structure of the organism under-goes a change when passing from the virulent to the avirulent state. Growth experiments with bacteria have shown no marked change when virulent or avirulent strains have been used. But from such experiments done in a medium containing many substances, it is not possible to get information about the ability of the organism to oxidize different energy sources. For the purpose of this study, therefore, oxidation of individual substrate was studied employing the Warburg manometric technique, 'Resting' washed cell suspensions, usually in vogue for such studies were used. Oxygen uptakes were determined at 15 minutes intervals for 2 hours at 27°C. Seven strains of the plague bacillus three virulent and four avirulent, have been studied, employing about twenty-five different substrates including carbohydrates, amino acids and organic acids. The results showed that the enzymatic properties of the cells of the plague bacillus in the virulent and avirulent strains studied show no difference.

### 10. Effect of sulphha drugs on the oxidation by plague bacillus.

S. K. GOKHALE, Bombay.

The inhibitory effect of the sulphha drugs on the oxidation by some pathogenic organisms has been the subject of intensive study in recent years, but most of the work is with organisms other than plague. The present investigation is taken up to study the action of some of these drugs on the 'respiration' of the plague bacillus in different substrates and in relation to the stimulating effect of coenzymes like para-aminobenzoic acid. Oxygen uptakes were measured by the Warburg manometric technique of 'resting' washed cell suspensions of the bacteria. Different substrates and different concentrations of the drugs were used. The comparative inhibitory effect of the different drugs is also being studied. Results obtained with different concentrations of sulphathiazol are discussed.

### 11. The carotenoid pigments of common leaves and other tissues of plants.

J. C. SADANA and BASHIR AHMAD, New Delhi.

Common leaf and stem tissues of plants are known to contain the two principal carotenoid pigments, xanthophyll and  $\beta$ -carotene. It is found on pursuing this study intensively that at least five carotenoid pigments are present and their amounts continue to change during the development of plants tissues. Apart from the fact that this study may throw light on the role of carotenoid pigments in plants, it has helped to obtain a more accurate estimate of vitamin A potency of these tissues by taking into account the amount and biological activity of individual carotenoid pigments present at any stage.

The different leaves examined showed the presence of xanthophyll,  $\beta$ -carotene, pseudo- $\alpha$ -carotene, carotenoid X and another unidentified pigment. Xanthophyll and  $\beta$ -carotene no doubt are the two main pigments. In gram leaves these pigments represent 69.4% and 26.3% of the total pigments respectively, the remaining pigments being only 4.3% of the total. The fact however that they are always present points to some essential relationship.

From among the roots the classical example of carrots may be taken. Seven pigments xanthophyll,  $\gamma$ -carotene,  $\beta$ -carotene,  $\alpha$ -carotene, pseudo- $\alpha$ -carotene, neocarotene and an unidentified pigment which is absorbed on the column between  $\gamma$ -carotene and  $\beta$ -carotene are present. It is of interest to note that in red varieties,  $\beta$ -carotene was the main pigment and formed 60-86% of the total pigments. Where as in Orange Carrots,  $\alpha$ -carotene was the main pigment and formed 34-52% of the total pigments,  $\beta$ -carotene being 13.3-31.9% of the total. In pink, violet and yellow varieties xanthophyll was found to be the main pigment and formed 75-93% of the total pigments. The vitamin A potency varied from 102-225 I.U./g for red, 14-31 I.U./g for orange and 0.2-3.0 I.U./g for violet, pink, and yellow varieties.

## 12. Preparation of desoxycholic acid from Indian ox bile.

U. P. BASU, Calcutta.

It is difficult to isolate desoxycholic acid from the bile acids that are normally present in gall-bladder bile. Desoxycholic acid readily forms "choleic" acid and as such the usual preparation that requires crystallisation of the acid from acetic acid affords "acetic acid choleic acid" m.p.  $142^{\circ}$  (cf. Gattermann, Laboratory Methods of Organic Chemistry, 1937). The acid has also been prepared synthetically from cholic acid by Haslewood (*Biochem. Jour* 1943, 37, 109).

The paper describes a method of preparation of pure desoxycholic acid from Indian ox bile. The pure acid melts at  $176^{\circ}$  and may be used in bacteriological culture work. Along with this pure acid the "acetic acid choleic acid" (m.p.  $142^{\circ}$ ) which is a mixture of acetic acid and desoxycholic acid, is also obtained as desoxycholic acid helps in the absorption of fat, and fat soluble vitamins in the system, incorporation of a trace of the above desoxycholic acid complex with the usual purified bile salts, is being suggested.

## 13. On the characteristics of "Peptones".

N. ROY, Calcutta.

Peptone is largely used in bacteriological culture work, and is generally prepared by enzymatic hydrolysis of protein body. The enzymes used, are pepsin, papain or trypsin. As these enzymes act differently, the fragmented molecules of protein would differ in their chemical characteristics. With a view to find out the differences in their properties, casein was hydrolysed with each of the above enzymes at  $50^{\circ}$  C at optimum pH and the digested solution was filtered and evaporated to dryness to afford three types of peptone powder.

These were analysed and the degree of fragmentation was determined by various processes. It is being found that the average relative number of peptide linkages present in peptic, papain and tryptic peptone is 9, 8 and 2 respectively.

## 14. On the amino acids content of liver preparations.

S. K. GANGULY and P. N. SEN GUPTA, Calcutta.

A most recent addition to the group of purified nutritional substances is the use of a mixture of various essential amino acids as a source of protein food. Liver which is largely used in therapy contains apart from proteinous body a number of vitamins and minerals. The factor which is responsible for its efficacy in anæmia, is not definitely known. The researches of Jacobson and Subbarow (*J. Clin. Invest.*, 1937, 16, 573) tends to show that L-tyrosine as present in liver protein may play a part in enhancing its physiological property. As liver is being used in different form—whole liver powder, proteolysed liver, Cohn fraction G and Extractum Hepatis siccum, it was considered to be of interest to study the amino acids content of the above preparations of liver. These have been carried out and the results are being incorporated in the body of the paper. It may be mentioned that the tyrosine contents of the protein of whole liver powder, proteolysed liver, Cohn fraction G and Extractum Hepatis siccum on dry basis are 3.3, 3.0, 1.3 and 1.0 per cent respectively. Proteolysed liver is being found to retain all the constituents of raw liver, and as such its value in special types of anæmia is being indicated.

15. Thiaminase system in fresh water mussel (*Lamellindins marginalis*).

K. K. REDDI, K. V. GIRI and R. DAS, Bangalore.

Fresh water mussel (*Lamellindins marginalis*) contains an enzyme system which destroys vitamin  $B_1$ . The enzyme can be extracted from the visceral mass with water. The enzyme is optimally active at pH 3.6 and 6.5. This suggests the presence of two enzymes in the extract with two different optimum pH. The difference in the stability of two enzymes and their behaviour towards inhibitors and activators support the view that there are two enzymes in the extract. Sodium fluoride and iodo-acetic acid up to 0.01 M. have no effect on the enzyme at pH 6.5 while at pH 3.6 iodo-acetic acid inhibits the enzyme to some extent. The loss of thiaminase activity on dialysis can be restored by M/1,000 manganese sulphate. Copper sulphate inhibits the activity at both pH 6.5 and 3.6.

The partial purification of the enzyme is described. Further investigations on purification and chemical nature of the enzyme are in progress.

16. Blood clotting factor in castor seed (*Ricinus communis*).

I. M. CHAK and K. V. GIRI, Bangalore.

A factor which induces the coagulation of blood plasma in presence of calcium has been shown to be present in castor seed. This factor can be extracted with water. The nature and behaviour of the factor on blood coagulation have been compared with the thromboplastin activity of Russel Viper venom. Just as in the thromboplastin of a snake venom, the factor present in castor seed does not coagulate the plasma in absence of calcium. The blood clotting activity of the factor increases on keeping the aqueous extract at 8-10°C. Dialysis and ultrafiltration of the aqueous extract inactivates the factor. When compared to Russel Viper venom, this factor is more specific for the coagulation of bovine blood plasma than for human plasma.

Further investigations on the purification and chemical nature of the factor are in progress.

## Nutrition

## 17. Protein hydrolysates from oilseed cakes.

S. KUPPUSWAMY and K. V. GIRI, Bangalore.

Predigested protein concentrates from the various oilseed cakes such as groundnut, cottonseed, sesamum and cocoanut cakes have been prepared by digestion of the cakes with papain. The products thus obtained were analysed and found to compare well with marmite and other yeast extracts in many respects. The final concentrates contain the bulk of the proteins, minerals and vitamins present in the cakes. The supplementary value of these concentrated to poor rice, South Indian diet and the biological values of the proteins of the concentrates as compared with the biological values of the proteins of the cakes themselves before digestion are under investigation.

## 18. The lipatic activity of soya beans and of soya milk.

V. MAHADEVAN, S. S. DE and V. SUBRAHMANYAN, Bangalore.

In a systematic study of conditions governing the production of soya milk of a quality and composition approaching that of cow's milk a study of its lipatic activity was undertaken as a part of the programme. For this purpose both soya milk and the crushed beans as such or after germination were used as sources of lipase and the extent of hydrolysis after 24 and 48 hours generally was estimated by titration with alkali, using the milk as such as well as after admixture with definite quantities of either added soya bean oil or groundnut oil. In all about eleven such experiments were carried out at room temperature 25° and the results show that the greatest activity was obtained with soya milk and added soya oil. The lipase in soya beans is more active towards soya bean oil which it hydrolyses to the extent of 50% in 48 hours, but not so effective in the hydrolysis of groundnut oil. The lipatic activity is found to deteriorate on heating soya milk. The effect of lipase on the development of flavour in soya milk and soya milk products is being studied.

## 19. Ascorbic oxidase in soya bean.

Y. B. RANGNEKAR, S. S. DE and V. SUBRAHMANYAN, Bangalore.

During the course of studies on vitamin C in soya bean, it was observed that germinating beans contain a powerful ascorbic oxidase whose activity reaches maximum after about 48 hours' germination. The germinated beans were extracted in hot water for different time periods and it was found that extracting the beans at 75° for 10 minutes inactivates the enzyme completely with slight loss in the final vitamin C value of the soya milk.

The preparation of the enzyme from the germinated beans (48 hours) was carried out by repeated precipitations with saturated ammonium sulphate, dialysis against distilled water for 60 hours and then absorption on alumina. The final enzyme preparation was about 230 times as active as that present in the crude extract and contained 118 microgram of Cu. per gram.

## 20. Isolation of oestrone by selective absorption on calcium hydroxide.

E. G. MONTGOMERY and P. DE, Calcutta.

The benzene extract from pooled samples of urine from a case of feminism is passed through a column of calcium hydroxide. The isolated oestrone was assayed by biological test and also confirmed by the melting point. This method of isolation is convenient and appears promising for large scale work.

## 21. A case of feminism.

P. DE and E. G. MONTGOMERY, Calcutta.

A case of feminism suggestive of adrenogenital syndrome in a boy of about 20 years has been investigated. The boy had enlarged breasts with atrophy of penis and testis and had feminine distribution of fat and hairs. The symptoms were reported to have started about 2 years ago with gradual increase. An excess of oestrogen in the urine was shown by 'biological test' on mice. Exact quantitative measurement in international units of the oestrogen was not possible because of the widely varying rate of excretion from day to day.

## 22. Vitamin C in soya bean and soya milk.

Y. B. RANGNEKAR, S. S. DE and V. SUBRAHMANYAN, Bangalore.

Raw soya bean and the milk prepared from beans soaked for 5-6 hours has practically no vitamin C content. Soya milk prepared from 72 hours germinated bean contains 22.6 mg. vitamin C per litre, an appreciable part of it is present as the biological active dehydro-ascrobic acid. The vitamin C content of the soya milk prepared from different varieties was also estimated and it was found that white varieties give much higher values of ascorbic acid.

A notable point about vitamin C in soya milk as compared to cow's milk is its much higher stability against oxidation owing to copper catalysis. Whereas on exposure to bright sun light, the vitamin C destruction in cow's milk as caused by the photochemical sensitization due to the existing riboflavin was to an extent of 90% in two hours, it was extremely small, only about 2% during the same period in soya milk, even when the riboflavin content was made the same as that of cow's milk. No marked destruction of vitamin C was observed in soya milk subjected to ultra-violet irradiation. These findings clearly indicate the presence of a protective factor for vitamin C in soya milk and its absence in cow's milk. A further confirmation of this was sought in the observation that vitamin C in cow's milk mixed with an equal volume of soya milk was more stable than in pure cow's milk alone under the above conditions.

## 23. The vitamin A content of fish liver oils and carotene content of some foodstuffs.

A. R. SUNDARARAJAN, Coonoor.

Chemical assays of foodstuffs to assess their nutritive value have been in progress in these laboratories for the last few years. The present paper records data for the vitamin A activity of some fish liver oils and foodstuffs.

The vitamin A potency of seventy-three samples of shark liver oils obtained from various parts of India was found to be on an average 9,300 I. U. per g.

Fish liver oils blended with a vegetable oil to correspond in potency to that of B. P. Cod liver oil and sold to the public as such, had on an average only 870 I. U. per g. instead of the required 1,500 I.U.

The body oils of fishes are a poor source of vitamin A.

Red carrots and amaranth leaves are good sources of carotene while white carrots contain little carotene. The juice of the palm fruit (*Borassus flabellifer*) which has a deep yellow colour is a fair source of carotene.

## 24. Scurvy in rats and rabbits.

M. N. RUDRA, Darbhanga.

It has been possible to produce in rats and rabbits signs which are almost identical with scurvy in guinea pigs by giving the former a diet which has been purified to contain a minimum amount of manganese.

## 25. Vitamin C requirement of man.

M. N. RUDRA, Darbhanga.

There is a wide difference of opinion about the vitamin C requirement of man. Amounts as low as 10 Mg. daily and even less and as high as 100 Mg. daily have been claimed as justified by experiments. The author opines that these widely variant claims can be explained by assuming that man, under suitable conditions, can synthesise at least part of his vitamin C requirement and under those conditions a low daily intake will be justified. There is some experimental evidence to support the author's hypothesis.

## 26. Investigation into the dietary standards of a group of residents in the urban area of Delhi.

G. S. SAHARIA, Delhi.

An investigation into the food intake for the first time of the residents of Delhi was carried out, a hostel was the place of observations.

The proximate principles, Calorie value of the diets as well as average intake of milk, and milk products, leafy vegetables and fruits have been estimated.

The findings have revealed that the Calorie requirements are of an extremely low order and with this low intake the minerals and vitamins also fall short of the optimum. The intake of the leafy vegetables was very poor. The diet is much on the negative side of the recommendations of the Indian Nutrition Advisory Committee.

A smaller percentage seems to supplement from outside sources but the majority have to depend on the food provided by the mess in the hostel and it being insufficient is liable to impair their health.

Some suggestions for the inclusion of roasted ground-nuts, skimmed milk, leafy vegetables which may ensure an adequate supply of minerals and vitamins have been made.

It has also been suggested that a wholtime nutrition trained man may be profitably employed to look after the food of the inmates of the hostel, which would improve the diets at a lower cost.

## 27. Investigations on the nutritive value of the cocoanut.

V. SADASIVAN, Coonoor.

In the West Coast of India comprising the districts of S. Kanara and Malabar and the States of Travancore and Cochin, the cocoanut is the chief oilseed crop. It also enters into the composition of the diet in these parts as the fresh kernel and as the oil. To a much lesser extent, tender cocoanuts are also consumed.

Though the cake is normally utilized as a cattle feed, it is consumed by the very poor during periods of scarcity of rice. Hence a detailed study of the nutritive value of the cocoanut was considered desirable.

The kernel is very rich in fat (65-70%) and the oilcake contains 20-24% of crude protein. About 56% of the total nitrogen is in a form easily extracted by water. The true proteins as estimated by precipitation with 10 per cent trichloroacetic acid amounts to about 68% of the total nitrogen of aqueous extract. Cocoanut water (by which is meant the water in the hollow portion of the nut) contains no appreciable amounts of protein.

The carbohydrate complex of the fresh kernel consists of about 2-3% of reducing sugars, 8-9% of hydrolysable sugars and 7-8% cellulose. The oilcake contains 3-4% of reducing sugars, 23-25% of hydrolysable sugars and 17-19% cellulose.

The phosphorus complex in the fresh kernel is mostly in an acid-extractable (10 per cent trichloroacetic acid) form (about 85% of the total). Phytin phosphorus was present only to the extent of nearly 11-12% of the total, the rest of the phosphorus being probably in an easily assimilable form. The kernel has been found to be very poor in the important vitamins. Thus carotene and riboflavin are almost absent while thiamin, niacin, pyridoxine, choline and ascorbic acid are present only in comparatively small amounts. Experiments on the supplementary value of cocoanut cake for diets based on tapioca are in progress.

## 28. Supplementary value of oilcake proteins in diets based largely on roots and tubers.

S. RANGANATHAN, Coonoor.

In view of expert recommendations for making use of roots and tubers (like sweet potato, tapioca, etc.) as a partial substitute for cereals, it was felt desirable to attempt to overcome the protein deficiency of such cereal-tuber or root diets. The increasing

number of hydrogenation factories in India will sooner or later result in a relative glut of oilcakes. Being rich in proteins, they naturally suggested themselves as suitable for supplementing such cereal—tuber or root diets. Since groundnut enters largely into the *vanaspathi* industry, experiments on the supplementary value of groundnut cake were carried out to begin with. Encouraging results have been obtained. Experiments are under way extending the present investigations to diets containing either wholly of roots and tubers or cereal—root-tuber diets, simulating the present-day emergency rations obtaining in South India. The experiments, if successful, will help achieve a two-fold object; improving the emergency rations and diverting the use of groundnut cake from manure to human consumption.

### 29. Digestibility and nutritive value of Paker leaves (*Ficus infectoria*) at three stages of maturity.

S. A. MOMIN and N. D. KEHAR, Izatnagar.

Feeding trials were carried out with Paker leaves at three different stages of maturity—(1) young (2) mature and (3) tree-shed leaves. It was observed that the digestibility and nutritive value of leaves decreased as they advanced in maturity.

The nutritive ratio varied from 7.47 at the young stage to 70.20 at the leaf shedding stage. The percentage of digestible crude protein declined from 7.27 lb. per 100 lb. dry matter in the early stage to 4.01 at advanced maturity. The total digestible nutrients also fell from 61.99 lb. in the early leaves to 32.23 lb. in the old and dry ones; while the corresponding changes in the value of starch equivalent on dry matter basis were from 44.09 lb. to 30.04 lb. and finally to 17.25 lb.

### 30. Digestibility and nutritive value of Bhanjura grass (*Apluda Mutica*) hay.

N. D. KEHAR, S. C. RAY and I. P. AGRAWALA, Izatnagar.

The hay used for the experiment was from the grass cut in October. The composition of the sample expressed on dry basis was 4.05 per cent crude protein (C.P.), 1.03 per cent ether extract (E.E.), 41.4 per cent crude fibre (C.F.) and 80.62 per cent total carbohydrates (T.C.). The lime and phosphate contents of the hay sample were normal.

\*The hay was fed *ad lib.* with a supplement of linseed cake to bring the diet to maintenance level. The digestibility co-efficient of C.P., E.E. and T.C. was found to be 17, 16 and 59, respectively. The nutritive value of the hay calculated from the digestibility data was 0.68 lb. digestible crude protein and 49.0 lb. total digestible nutrients per 100 lbs. of the dry hay.

### 31. Digestibility and nutritive value of Usar grass (*Sporobolus arabicus*) hay.

N. D. KEHAR, S. C. RAY and S. S. NEOGI, Izatnagar.

The sample of hay used for the digestibility determination was made of the grass cut in the month of October. The composition of the sample expressed on dry basis was: 6.12 per cent crude protein (C.P.), 1.02 per cent ether extract (E.E.), 34.39 per cent crude fibre (C.F.) and 84.02 per cent total carbohydrates (T.C.). The lime and phosphate contents of the grass, which were 0.30 per cent 0.33 per cent, respectively, were definitely subnormal for a good quality hay. Usar grass is characterised by the presence of excessive quantity of sulphur and soda.

The ration consisted of the hay (*ad lib.*) and a small supplement of rape cake to bring the diet to maintenance level. The digestibility co-efficient of C.P., E.E. and T.C. of the hay was found to be 42, 41 and 43, respectively. The nutritive value, on the basis of digestibility data, was 2.55 lb. digestible crude protein and 39.59 total digestible nutrients per 100 lb., of dry Usar grass.

It has been observed that inspite of sufficient supply of calcium and phosphorus in the ration containing Usar grass, the balance of these minerals had turned out negative. The peculiar disposition of the minerals in the grass is suspected to be the causal factor and further work on this line is in progress.

### 32. Nutritive value of Soya-milk cake.

S. S. DE and V. SUBRAHMANYAN, Bangalore.

The residue after preparation of the milk comprises 25-30% of the original bean. The cake contains high percentage of protein (about 60%) and contains 2-3% of fat. It is practically free from the bitter principle which is present in the raw bean. The

composition and the nutritive value of the cake have been determined. The supplementary effect of the cake to poor rice diet was determined and it was found that the weekly average increase in body weight with the basal diet was 3.5 gm. and with 10% cake as supplement, it was 6.4 gm. The biological value of wheat flour supplemented with 10% of the cake was found to be about double that of the wheat flour alone.

### 33. Supplementary value of the proteins of oilseed cakes to proteins of South Indian diet.

S. KUPPUSWAMY and K. V. GIRI, Bangalore.

In this experiment, designed to find out the supplementary value of the proteins of the four oilseed cakes to the proteins of South Indian diet, the control (South Indian) diet was made complete in all respects by the addition of salt mixture, calcium lactate, fat and vitamins, while the experimental diets themselves were so prepared, that in addition to the above mentioned factors, they contained the same percentage of protein as the control diet, half of which was derived from the different oilseed cakes and the other half from the control diet. No significant difference were observed in the biological value of the mixtures of rice (South Indian diet) protein and the proteins of the oilseed cakes, as determined by the growth method. This clearly showed that the varying supplementary effects shown by the oilseed cakes when used as sole addenda to South Indian diet is due not to the proteins of the cakes, but to some other factor present in their presumably calcium.

### 34. Supplementary value of oilseed cakes to poor rice South Indian diet.

S. KUPPUSWAMY and K. V. GIRI, Bangalore.

The supplementary value of groundnut cake, cottonseed cake, sesame cake and cocoanut cake to poor rice South Indian diet was determined by growth experiments with young albino rats. The control (South Indian) diet was made up predominantly of raw rice with small addenda of red gram and black gram, while the experimental diets consisted of a mixture of this basal diet and the different oilseed cakes in such proportions that the total protein content of the diets was the same in all cases (12%). The average weekly increase in the weights of the rats on the control, groundnut, cottonseed, sesamum and cocoanut cakes were respectively 2.5, 3.1, 6.6, 6.1 and 7.5. Thus all the oilseed cakes except groundnut cake showed fairly good supplementary value. But, the experiment could not show conclusively whether the supplementary effects were due to the proteins in the cakes or to other factors present therein, especially because varying proportions of the cakes had to be used in preparing the experimental diets, depending on the varying protein content of the cakes. However, knowing that calcium is the chief deficiency in South Indian diet, it could be easily surmised that the calcium present in the cakes was largely responsible for their supplementary value to South Indian diet.

### 34a. Thiamine Status of people of Orissa.

K. SUBRAMANIAM and S. M. BANERJI, Cuttack.

The colorimetric method of Melnick and Field as modified by Hochberg and Melnick has been used to determine the thiamine status of a group of people in Orissa. The Vit B<sub>1</sub> status as determined by this method is found to be below normal in a majority of cases. The results are of great importance in a general nutritional survey.

## General Physiology

### 35. An introduction to the study of the physical nature of vowels and consonants\*.

C. R. SANKARAN and S. ROURIRAJAN, Poona.

It is shown that the consonant-nature is of a continuous, monophasic and unfunctional type. The various partials constituting the consonant vibration are in a state of incessant oscillation within the closed interval of the consonant. The duration of a consonant (which is also its sub-duration) is non-variable, and is its fundamental functional property and not its periodic property. In a complete temporal order, whereas vowel nature is of a pure-periodic type the consonant-nature is *almost-periodic*.

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36. The role of adrenal medulla on the glucose tolerance test in normal and scorbutic guinea pigs.

SACHCHIDANANDA BANERJEE and NARESH CHANDRA GHOSH, Calcutta.

The adrenaline content of the adrenal glands of scorbutic guinea pigs was found to be higher than those of normal paired fed animals. The scorbutic guinea pigs also showed diabetic type of glucose tolerance curves. The effect of the removal of adrenal medulla on the glucose tolerance test was, therefore, studied. Adrenal enucleation was performed in guinea pigs. Twenty-one days after the operation the animals were paired and one group was given a scorbutic diet while the other group received the same diet with the daily supplement of 5 mg. of ascorbic acid per mouth for twenty-one days. Another group of guinea pigs with intact adrenals, given the scorbutic diet with the daily supplement of 5 mg. of ascorbic acid, served as controls. The food consumed by the animal of the scorbutic group was weighed daily and the same amount of food was given to the corresponding animals of the other two groups. The glucose tolerance test was performed in all the animals after twenty-one days. The adrenal enucleated guinea pigs showed diabetic type of glucose tolerance curves while the animals with or without intact adrenals receiving ascorbic acid showed normal glucose tolerance. Adrenal medulla does not seem to affect the glucose tolerance test in guinea pigs.

37. Antiketogenesis and Ketolysis: Studies on the oxidation of acetoacetic acid in vitro as well as in vivo.

M. C. NATH and A. H. M. HABIBUL ISLAM, Nagpur and Dacca.

Normal plasma has been found to cause great influence in the process of oxidation of acetoacetic acid with hydrogen peroxide in alkaline medium. Oxidation of acetoacetic acid takes place in vitro with normal plasma alone in alkaline medium even without hydrogen peroxide. Amellin the new antidiabetic plant product also causes enormous effect in the process of ketolysis in vitro with  $H_2O_2$  in presence of alkali. The nature of oxidation caused by glucose +  $H_2O_2$  differs greatly with that with either amellin +  $H_2O_2$  or plasma with or without  $H_2O_2$ ; there is observed an initial latent period in case of the former while in the latter cases the acceleration begins at the very beginning. Plasma from—diabetic blood is far less effective in helping the process of ketolysis in vitro thus indicating efficiency of some factor in it. Amellin has been found to cause ketolysis in vivo while injected simultaneously with acetoacetic ester in normal rabbits.

38. The effect of water washing rice straw on its composition and metabolism in ruminant system.

S. C. RAY, A. W. ZUBAIRY and N. D. KEHAR, Izatnagar.

Water washing effects about 17 per cent loss in dry matter, significant portion of which is due to the removal of fine dust adhering on the surface. The outstanding changes in the chemical composition are lowering of potassium from 1.63 per cent to 0.54 per cent and soluble oxalate, from 1.16 per cent to 0.11 per cent. These changes indicate that a very considerable portion of deleterious potassium oxalate in paddy straw is removed by the treatment.

The salient metabolic features in the feeding of washed straw as contrasted to untreated straw are:

- (i) The reduction in diuresis by about 40 per cent.
- (ii) The lowering of urinary pH from 8.7 to 8.1.
- (iii) The reduction of alkali concentration in urine by over 70 per cent.
- (iv) The elimination of alkalosis helped in the calcium balance from—0.13 gm. to +1.39 per animal per day.
- (v) The percentage utilization of digested protein increased by almost 50 per cent.

The feeding trials indicated that the animals consumed 12.5 per cent more of dry matter when the straw was washed. But for slight lowering in the digestibility co-efficient (from 62 to 58) in total carbohydrates, washing seemed to have no effect on the digestibility of the straw nor on its total digestible nutrients.

39. Normal variations in blood haemoglobin of milch buffaloes.

N. D. KEHAR and V. N. MURTY, Izatnagar.

Investigations on day-to-day variations in haemoglobin were made on 12 healthy buffaloes and samples of blood were drawn from the ear vein between 11.0 and 11.15 A.M. daily for 5 days. The average value was 7.35 gm. per 100 ml. of blood.



Studies on diurnal variations were made on nine healthy animals for 2 days and on another set of 3 animals for three days. Samples of ear blood were obtained at intervals of 3 hours from 9 A.M. to 6 P.M. The blood hæmoglobin level declined as the day advanced. The average fall in the case of 9 animals was 0.87 gm. and 0.96 in the other three cases per 100 ml. of blood.

#### 40. Some observations on the effects of nicotinic acid.

N. M. BASU and G. N. BERA, Calcutta.

The administration of nicotinic acid or nicotinamide to patients may lead to a marked flush in the face and some times temporary palpitation of the heart. Attempts were made to correlate these effects with its action, if any, on heart, blood vessels, and blood sugar.

Perfusion of frog's heart with nicotinamide does not reveal any appreciable effect, but vessel perfusion experiment, using a thermionic drop recorder, shows a vaso-dilator action. This accounts for flush of the face and reflex acceleration and augmentation of heart beat owing to fall of blood-pressure produced by vaso dilation. On taking the blood-pressure of a rabbit, while this drug is injected, there is a fall of blood pressure for a very short period during which the heart beat is accelerated. In determining the cause of this evanescent fall of blood pressure the effect of this drug on blood sugar was studied in the following way. The blood sugar curves of a rabbit fasting for 18 hours, were taken (1) after the intake of 3g. of glucose, (2) after the intake of 3g. of glucose, followed after 20 mins. by the injection of 12½ mg. of nicotinic acid, (3) after the simultaneous intake of 3g. of glucose and injection of 25 mg. of nicotinic acid, and (4) after the injection of 12½ mg. or 25 mg. of nicotinic acid but without any intake of sugar. In the course of the 3rd and the 4th series of experiments while blood was collected at different periods for estimation of sugar by Hagedorn's method, four drops of blood were simultaneously taken each time, diluted with Ringer's solution and immediately perfused through frog's heart.

The results of these experiments show that the injection of nicotinic acid 20 minutes after the intake of sugar gives a distinctly higher blood sugar curve than the intake of sugar alone, whereas the simultaneous intake of sugar and injection of nicotinic acid produces a still more pronounced rise in blood sugar, but the injection of 25 mg. nicotinic acid alone, *i.e.*, without any intake of sugar, causes a slight rise in blood sugar, 12½ mg. of nicotinic acid having no effect on blood sugar. Further, tracings of frog's heart beat after perfusion with diluted blood show increase in acceleration and augmentation, somewhat proportionate to the increase in blood sugar, although this excess of sugar was found not to be responsible for this change. The beats were not affected 20 minutes after the injection of nicotinic acid, when its concentration would be high, but at a much later period when the rise of blood sugar was quite pronounced, while the concentration of nicotinic acid is expected to be much lowered.

These results point to the conclusion of liberation of some substance in blood, which affects blood sugar and heart beat simultaneously. It is concluded that the substance in question is adrenaline. The cause of the evanescence of the fall of blood pressure after nicotinic acid injection is under investigation.

#### 41. A modified neon stimulator for student use in nerve muscle experiments.

N. N. DAS and B. B. SARKAR, Calcutta.

A simple apparatus has been devised to work from 220 D.C. mains, which is used for all purposes in conducting the experimental work on nerve-muscle physiology. It is well-known that the condenser discharging through neon bulb is in general superior to induction coil as regards the stimulation of nerve muscle preparations. The existing "neon-stimulators" are not suitable for all round work, for in that there has been a difficulty in obtaining two stimuli in quick succession by means of the rotating contact arms of the recording drum, as in summation experiments etc. One of the disadvantages is that the time of contact of each arm may be compared with the duration of "break" between them. Thus when a high charging resistance is used, the condenser has insufficient time to recharge ready for the 2nd stimulus, while with a lower resistance it may charge so rapidly that the time of discharge becomes very short and discharges twice during each contact period giving four stimuli instead of two. The present stimulator was devised in such a way that there is a single discharge at each contact.

In this apparatus, which is very compact, two neon lamps have been used instead of one. One of the lamp is working as "Stabilizer". The adjustment of proper resistance, condenser and leaky grid arrangement has made it possible to work up to desired extent. The strength of the stimulating current can be varied by the adjustment of a variable resistance. The frequency of the current can be regulated from 5 to 1000 per second, with the help of variable condensers. A circuit diagram is included along with the paper.

## SECTION OF PSYCHOLOGY AND EDUCATIONAL SCIENCE.

PRESIDENT : P. S. NAIDU, M.A.

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### General Problems

#### 1. The fundamental character of Scientific Psychology.

I. LATIFF, Lahore.

A plea is advanced for rescuing Psychology from the grip of Metaphysical and mythical speculations ; and for establishing it on the basis of biological sciences.

#### 2. The superconscious in the East and West—a comparative study.

(MISS) LEELA SINHA, Allahabad.

In India the beginnings of the study of the higher levels of mind go back to the days of the Vedas and the Upanishads. The system of Yoga of later India is an important contribution to the growth of the psychology of the superconscious. Its emphasis on the education of the soul, and on the control of the outgoing tendencies of the mind helps us to understand the functions of the superconscious.

The field of Western psychology is limited to the conscious, the subconscious and the unconscious. Western psychology refuses to consider the spiritual level. But how can psychology escape its responsibility when it declares its field to be mind ? Freud maintains that the super-ego is the representative of our relation to our parents, and that it is reducible to the unconscious. This attempt fails to satisfy us.

Western abnormal psychology would greatly be enriched by proper and scientific researches in the field of the superconscious. The application of the doctrines of the East to Western psychology need not confuse the psychological issues, as the former is based on rational and scientific grounds. Materialism may not be the last word in psychology.

#### 3. Psychology, its aims and future needs.

N. W. MORTON, New Delhi.

Varied historical influences have tended to create a diversity of interests and skills among psychologists. Wartime experience, however, has raised questions as to the essential constituents of psychology, its social significance, and the capabilities of psychologists as persons. It is suggested that psychology, whether "pure" or "applied", must realistically be devoted first to the study of individual personality and subsequently to generalisations upon behaviour and to the examination of part-processes in mental life. This implies not only fresh agreement as to what is primary and what is secondary in psychology, but also the need for the psychologist to immerse himself more fully in the actualities of daily life, for more exacting standards in the selection and training of graduate students, and for a closer relationship between undergraduate teaching and the students' personal requirements for living.

#### 4. The first course in Psychology in U. P.

J. G. VARMA, Allahabad.

1. An examination of the contents of the first course as it obtains in this Province under the following heads : (a) General Psychology, (b) Educational Psychology and (c) Child Psychology.

2. Lack of orientation in the course and absence of Laboratory work.

3. Correlation between the course and students' attitudes and interests.

4. Does the course satisfy the psychological needs of the adolescent boys at the

Intermediate stage ?

5. How the course may be profitably re-organised in respect of :
  - (a) the curriculum which should be psychologically oriented,
  - (b) the laboratory work which should be compulsory,
  - and (c) the practical applications of the laws and principles studied in the class.
6. Suggestions for framing a syllabus and for writing suitable text-books.
7. Is uniformity of curriculum in all the Provinces necessary ?
8. Conclusion.

## 5. The response of the external world.

SRIMANT LAL DAS, Patna.

The paper deals with the "Response of the External World", a new idea, and proposes "Response Psychology" as a new science describing "the response of reaction of the external world to man's inner mental state, and other allied phenomena, especially the response of the inner world."

The following laws governing the response of the external world are described : The Law of Expectation ; The Lull before the Storm ; "Nature abhors a Vacuum" ; The Law of Attraction and Repulsion ; The Creative power of the Human mind ; etc.

This Response Psychology may create a revolution in Science, (a) by showing that a desired result (in the external world) can be achieved without moving so much as a straw in the external world, (b) by attempting to explain certain religious phenomena not by invoking supernatural agencies, but by laws of nature which observation and experiment show to be true on this earth.

To use the phrase of Comte, "religion having passed through the 'theological' and the 'metaphysical' stage should now enter upon the positive stage."

## 6. The role of emotions.

RAMLAL, Allahabad.

The determining force of a man's conduct is not provided in the principle of rationality. Reason is only the servant of the inner emotional forces. Exaltation of reason is due, among other causes to our inability to view the ways of man objectively.

We are energised by emotions, but also inhibited by them sometimes. We cannot bottle up emotions and live a healthy life. A normal expression of the feelings and emotions is essential to mental health.

## Experimental Psychology

### 7. Types of relations expressed by the Conjunction "because".

MISS S. B. GUPTA, Calcutta.

(a) Both causal and logical relations are understood by some children aged between 6 and 8 years.

(b) Socialisation of thought takes place.

(c) Some thoughts are undirected but mostly they are directed.

(d) Juxtaposition or inversion of facts has been noticed.

(e) A child between 6 and 8 reasons, but may be ignorant of formal logical justification.

(f) In using "therefore" 83.4 per cent of children showed (i) absence of conscious realisation (ii) absence of general propositions (iii) absence of deduction.

## 8. An experimental study of meaning by Rorschach method.

KALI PRASAD and H. S. ASTHANA, Lucknow.

The paper reports the conclusions of a series of experiments on emergence of meaning in Rorschach ink-blot on Ss varying from 10 to 35 years of age. An examination of introspective reports and responses showed :

I. (a) That the *fore-period*, *set* and *attitude* exercise important influence on *canalizing* the responses but *without determining* them.

(b) that meaning configurations "flash" rather than "develop".

(c) that the patterns appear even before any associations grow ; or even if the associations be supposed to arise the S fails to seize upon them.

(d) that associations develop *after* the response and their elaboration continue for sometime.

(e) that failing the spontaneous emergence of a pattern, the S attempts consciously, to explore the blot in the hope of "seeing" something.

(f) that the emerged pattern is first vaguely perceived but gradually becomes more and more defined as the S is able to see more details in the pattern.

II. A quantitative examination after Rorschach scoring technique showed that F% is invariably very high as compared to E.B. W is W! whereas Dr varies. There is also a great variation in the capacity for "seeing" meaning patterns in different individuals, and that this "seeing" does not appear to be correlated to age.

## 9. The correlation between Wiggley Block Test and school achievement.

HAKIM I. A. KHAN, Lucknow.

The Wiggley Block Test was given to 291 students of class VIII of Anglo-vernacular schools of Lucknow. The distribution of S's according to age was as follows :

Age in Years.	12—13	13—14	14—15	15—18
No.	70	94	67	60

The average time taken to build the block was 10.03 minutes with a standard deviation of  $\pm 5.892$ . The standard errors of the Mean and standard deviation are  $\pm 0.333$  and  $\pm 0.245$  respectively.

The correlation between the time taken to do the test and educational status as judged by aggregate marks in the final examination was found to be

$$\sqrt{r} = -0.3715 \quad P.E = \pm 0.03404.$$

## 10. Number choice in Indian children.

RAM MURTI LOOMBA, Lucknow.

A study of the choices of the individual numbers 1 to 15 from amongst themselves for a group of 929 Indian children of both sexes aged from 5 to 18 years.

## 11. A study of vocational preference of college students in Bihar.

B. DE, Patna.

The present preliminary study is patterned on a more extensive study on the same subject made by Prof. H. P. Maiti on college students on Bengal some years ago and is limited to 250 students of two Mofussil Colleges. Prevailing tendencies in vocational choice are indicated and an attempt has also been made to note the influence thereon of such special factors as age, caste, marriage economic conditions and educational outlook of the family.

## 12. Colour-blindness and camouflage.

RAM SINGH, Allahabad.

It is a well-known fact that to the colour-blind person nature appears draped in a sombre garb. The beauty of 'natural colours' perceived and enjoyed by the normal sighted man or woman is veiled from the vision of the colour-blind. This defect or abnormality, which is held to be mostly hereditary, is not without its compensating advantages. In the course of his service with the forces at the front the author discovered that the 'red-green' blind person could see through certain types of camouflage absolutely impenetrable to the person with normal eye-sight. Taking his cue from this striking experience on the battlefield, the author is engaged in investigating, with the aid of controlled experiments, the nature and extent of penetrability into the defensive camouflage of the army possessed by the 'red-green' blind person. The results seem to hold promise firstly of lucrative employment for the colour-blind hitherto rejected by certain services, secondly of outwitting the enemy in his efforts to deceive through camouflage, and thirdly of profit to society through psychological exploitation of the sensorily handicapped.

## 13. Bergson's conception of memory and its experimental verification.

UMA SANKAR SRIVASTAVA, Allahabad.

According to Bergson, memory consists of two forms: (1) mechanical or habit memory and (2) pure memory; the latter being peculiar to men only. Bergson's view has been sharply criticised. Many of his critics believe that the difference lies more in degree than in kind. The experiments of McDougall and Smith support this distinction while Sur inferred otherwise; but his experimental procedure is questionable. Some misunderstanding has also been caused by Bergson's confusion of mechanical and habit memories. The former is a type of conditioned reflex while the latter involves deliberate and conscious attempts which are peculiar to men. The two, therefore, should not be mixed up.

The pure memory of Bergson forms the basis of most of our further actions and hence comes very near to Spearman's 'G.' In an experiment, therefore, forty adults were given a Group Intelligence Test containing questions under headings, Memory, Number and Verbal, and the 'G' and 'S' saturations of each were worked out from the scores obtained under each heading.

The results lead us to support Bergson's-views.

## 14. Sex difference in memory span.

D. BAG, Santiniketan.

The paper reports the results of an investigation on the memory span of boys and girls, of the age range 9 to 15 in respect of four different types of materials. Certain significant differences are indicated. There is, on the whole, a definite tendency of superiority of girls over boys. An attempt has been made to explain this phenomenon.

## 15. Adolescence in India. (An enquiry into the age at which it begins.)

T. K. N. MENON, Baroda.

The sure method of finding the age of the dawn of adolescence is to find the age of first menstruation in the case of girls, and the testing of the urine of boys to detect the appearance of spermatozoa. It is agreed that if the age of puberty is fixed, adolescence can be taken to have started two years before the age of puberty.

The medical inspection records of a number of girls' schools in the Bombay Province were examined. Unfortunately almost all of them did not record this important detail. We could locate some of the girls' schools in Poona which had recorded the date of first menstruation in their medical inspection cards. Out of 600 such cards collected, we took into account only those of Brahmin girls of the middle class. We had 274 such cases. Their ages of first menstruation were statistically analysed. The average of puberty was found to be 14.31 with an S.D. equal to  $\pm 1.47$ . Conclusion: (1) Adolescence may be considered to start in the case of middle class Brahmin girls of Poona at the age of 12.31. (2) There is urgent need of similar investigation of children in other parts of India. (3) Medical inspection reports of girls should record the date of first menstruation.

## 16. The deeper motive in loving.

JNANENDRA DAS GUPTA, Calcutta.

The author devised a questionnaire with the help of which a rough quantitative assessment of two love-propensities of a person are made. The mean score in love-giving of 24 parents is 23.6 against 10.9, the mean of 108 children. The mean score in love-getting of parents is 23 against 38.5 of children.

Next two cases of one unmarried man and another unmarried woman were presented who had not progressed beyond their emotional babyhood. Their scores for love-giving were 5 and 2 respectively while for wish for love were as high as 44 and 40. They do not again love children because they have, thanks probably to the parental indulgence, remained children themselves. Next the two sets of answers of a more normal parent were considered. The first set was his conscious critical answers, the other was his immediate uncensored responses. In the first set of answers he came out as a more or less a loving father, his scores being in loving and in being loved 23 and 17 respectively. In his relaxed mood he sunk back into his infancy and his love vanished (score 1) while his wish for love rose as high as 47.

Certain interesting conclusions are presented.

## 17. Advertisement.

UDAI BHANU, Indore.

It is not an easy job to make a scientific study of advertisement. Several difficulties come in the way.

In the first place it is a man-made product. So it does not tell anything about the working of nature. Another difficulty is that we cannot exactly know its effect.

However, an experiment was arranged. It was advertised that at a particular place medicine will be available for rickety children. The observation was made for seven months.

The average number of persons who responded to it is ten per month. The rise and fall of the number is very irregular and no adequate explanation can be given for this.

## 18. Colour in advertisement.

UDAI BHANU, Indore.

The increase in the number of advertisements has decreased their attention value. Of all the factors which enhance attention, colour stands first. It is used in the background as well as in letters and figures printed on it. Sometimes the same colour is used with variation of degree and sometimes a variety of colours is used. Which is more effective in visual apprehension? Whether the former or the latter? This is the theme of this paper.

Four colours were selected—white, brown, green and yellow—four colours of ink—blue, black, red and green were used separately. One hundred meaningful words were written on them. 25 persons were tested.

The following conclusions are drawn from the experiment:—

- (1) Speed of correct reading depends upon legibility which demands contrasts between the colour of the paper and that of ink.
- (2) Black and white have the greatest contrast. Therefore, black ink produces the most legible text.
- (3) Marks achieved by blue ink are more than black. This, in my opinion, is due to the fact that, in addition to the colour contrast, blue is the most preferred colour.
- (4) When the same colour is used in the background and ink the speed of reading decreases and the number of mistakes increases.

### Psychoanalysis and Abnormal Psychology.

#### 19. A psychoanalytic interpretation of certain Indian Myths.

I. LATIF, Lahore.

An attempt is made to interpret the *Kali* myth in the light of the emotional biography of the believer.

#### 20. The role of unconscious phantasies in the onset of psychotic and Neurotic Disorders.

I. LATIF, Lahore.

Certain case-histories are presented in which the mental troubles of the patients are traced to the fact that their morbid phantasies under ordinary circumstances remain deeply buried within the depths of their unconscious.

#### 21. Some psychological mechanisms of poetic reaction.

S. P. TEJPAL, Patna.

The paper attempts partial analysis of two of the writer's own English poems by a technique which resembles to a great extent that of dream-analysis. Certain parallels between processes of dream formation and those of poetic composition are indicated. The paper ends with a critical review of Herbert Read's theory of Poetic Creation.

#### 22. A psycho-analytic study of children from birth to five years.

HAKIM I. A. KHAN, Lucknow.

The author discusses the following points in his papers:

1. Birth trauma and its psychological implications in the behaviour of the child.
2. Sucking and holding of objects in the child and fixations arising therefrom.
3. The child's first experience of pleasure and pain centred round sucking breast. This leads to the building up of fantasies, both sadistic and erotic.
4. However successful the weaning may be, the child never overcomes this situation forced upon him. This sometimes leads to character defects like greed, jealousy, temper tantrums, etc.
5. Regulation of sphincter reflexes is the most critical event during this period of infancy. Maladjustments often arise and may be traced to the difficulties of sphincter morality.
6. This is the period when play activities are most prominent—the nature of play objects. The development of social attitude, difficulties reconciling the demands of the individual (growth and maturation) and the demands of the society (process of acculturation).
7. During this period the attitude towards parents suffers important changes, e.g., the dependence and feeling of ambivalence.

#### 23. Psycho-analysis and dialectical materialism.

V. NARVANE, Allahabad.

Many of the misconceptions about psycho-analysis are due to the fact that it is considered in isolation from other aspects of modern knowledge. Marxism does not accept most of the objections brought against psycho-analysis, on the one hand, by orthodox philosophers, and on the other hand by the 'experimentalists.'

The concept of the unconscious is acceptable to Marxism to the extent it rids psychology of the immutable 'Laws of Contradiction' ("either man knows or he knows not"). Nor can dialectical materialists ignore the tremendous significance of the facts of neurosis and sexual repression unearthed by psycho-analytic research. But Freud fails to see that the mechanism of repression is primarily socio-economic, and that sex suppression itself coincides with the evolution of private property. The Oedipus Complex, too, is determined by a form of the family at a particular stage of social development.

Freud's theory of dreams can be lifted on a higher level if we regard dream-life as the dialectical 'other' of waking life.

Freud's conception of Nature (and also of Human Nature) is not elastic enough. He does not see the qualitative changes in evolutionary processes, he does not grasp that Nature moves in 'jerks' and 'leaps.' He opposes the biological to the psychological organism, instead of stressing that the former *becomes* the latter at a certain stage.

#### 24. Psycho-analysis of the super-natural factor in a personality. (A case of "Anxiety Neurosis").

S. K. AHMAD, Allahabad.

The hypothetical formulations of this paper are based on the clinical records of a case of 'anxiety neurosis.' The patient who is marked by his superior intelligence is a young man of about 23 years of age. He complained of being troubled often by premonitory dreams, the experience of which would follow, 'anxiety attacks,' 'expectant-dread' and 'sleep walking.'

The patient linked the 'expectant-dread' to the 'super natural' factor in his personality and therefore took his dreams as premonitory in their significance.

The psycho-analytical therapy elicited that the dream experience which preceded 'anxiety attacks' and 'expectant-dread,' giving the dream a premonitory sense was a derivative from the deep rooted exclusive and unassimilated 'complex of castration.'

The neurotic anxiety which would attach itself to certain convenient thoughts, giving them an obsessive shape such as—of dying, and of going mad, as revealed through analysis, was derived from the 'Castration anxiety.'

The dream-analysis revealed those 'affective situations' which our patient had suffered once and which still continue to appear during sleep, assigning to dreams a deluded premonitory sense.

#### 25. The theories of regression: McDougall and Freud.

S. K. AHMAD, Allahabad.

In this paper the inadequacy of McDougall's concept of regression has been emphasized. McDougall bases his theoretical foundations on the doctrine of 'abeyance,' according to which regression is a biological act necessitated by the loss of higher functions. Thus he contradicts his own psychology which stands 'purposivistic' all through, losing its 'purpose' on the question of regression. According to Hormic Psychology, life is a conative activity, striving towards a goal, looking forward. Hence 'progression' is the logical and ultimate 'purpose' of life, not 'regression.'

Whereas according to psycho-analysis, as has been attempted to be proved by the aid of certain cases of regression, life at bottom is dominated by the 'pleasure-principle,' which knows no ends other than hedonistic. But that pleasure must come in consistently with the external forces and be modified by the 'reality principle,' lest life perish.

But should the internal factor come into 'conflict' with the external factor of 'reality' the former will no more be consistent with the latter. It will regress downward into the unconscious to achieve its libidinal aims which are directed by the 'pleasure principle.'

This is how McDougall's fallacious theory, advocating that regression is not 'purposive,' is refuted in this paper.

#### 26. Role of anal eroticism in stuttering.

PARS RAM, Lahore.

This paper presents significant features of the personality of a stutterer of twenty years of age. Fantasies of rage, which had expressed themselves originally in inhibiting the process of defaecation were, in this case, transferred to the organs associated with speech. The role of these fantasies in determining his human relationship also became apparent in the course of treatment. Factors determining the choice of the organ for expressing rage have been commented upon.



## Psychological Testing

### 27. Selection of personnel for the public service.

D. J. WATTERSON, New Delhi.

The selection was in two stages:

Stage (1)—The procedure at a 3-day Civil Selection Board comprised half a day of psychological tests, half a day of group activities (such as group discussion and group tasks), and the remaining time spent in individual outdoor or indoor situation, and in interviews with the Board psychiatrist and one of the lay members. The programme was rounded off by a final group activity, the purpose of which was confirmatory.

Stage (2)—The half day of tests in the psychological department included two or three group tests of general intelligence, two projection tests and three questionnaires designed to elicit both factual and attitudinal material. On the basis of these test results and imaginative productions, interpretations were made by Testing Officers.

A number of practical problems in connection with the working of such Selection Boards are outlined and discussed.

Looking to the future, possible trends in such work are considered, partly with a view to improving the quality and economy of the procedures, and partly with a view to integrating activities of this kind into wider personnel programmes, the stage of selection described in this paper then becoming merely the opening phase in a continuing relationship between government and civil servant, or employer and employee, as the case might be.

### 28. Psychological aptitude and its testing.

H. P. MAITI, Patna.

Psychological aptitude does not always go with academic degrees in psychology. In view of increasing demand of technological application of psychological knowledge there is a need at present for scientific assessment of psychological aptitude. The paper makes an attempt to define the constituents of psychological aptitude, and to indicate how it can be tested by psychological tests. The paper is based on an actual study of such tests applied on persons who have either studied or are studying psychology at the post-graduate stage.

### 29. A preliminary report on the reliability and validity of a new non-verbal analogy test for adult illiterates.

S. K. BOSE, Calcutta.

The present writer constructed a new non-verbal analogy test and applied it to groups of schoolboys between the ages of 10 and 14, and to groups of illiterate recruits for mills and transport companies. The scores of this new analogy test were correlated with those of Passalong and Dearborn Formboard tests.

### 30. Construction and standardisation of a scholastic test in geography.

G. C. KACKER, Allahabad.

The try-out consisting of 120 questions in two forms A & B was administered to 100 subjects in Indian schools and to 28 subjects in European schools. 100 questions were finally selected.

The final test, containing 100 questions, was administered to 1,155 students of class IX in schools in different geographical regions of U. P. The mean was 49.9, the S. D. 16.2, and the Standard Error  $\pm .477$ .

The G. Q. for different ages was also determined.

Certain significant results depending on the region tested and on sex were noticed, and are reported in this paper.

A careful analysis of the results suggests that a scholastic test may also be used as an intelligence test.

### 31. Construction and standardisation of an attainment test in geography for class IX.

(MRS.) RANI TANDON, Allahabad.

The try-out, consisting of 200 items, was divided into 2 equal and continuous parts—drafts A and B. This was administered to 195 children of Anglo-Vernacular schools in U. P. The final test was constructed on the basis of this try-out.

1,047 children, including 198 girls, were finally tested.

The mean was  $43.56 \pm 3(0.51)$  : and the S. D. was 16.49.

A percentile scale was also prepared.

Though the test was meant for and standardised as a class group test, yet standardisation was also made on an age basis. The G. Q. for different ages was arrived at and the norms prepared.

The analysis of the results revealed significant differences due to the age, the parental profession and the caste of the testees.

### 32. Construction and standardisation of a group verbal intelligence test for 12 plus.

(MRS.) RADHA KAKKAR, Lucknow.

In conformity with the general plan of the Education Department of the University of Allahabad, I decided to construct and standardise tests for the age group 12 plus. Two hundred questions were framed for the initial try-out under the heads which have a high correlation with 'g.' These 200 items were divided into two drafts and tried on 100 children. After calculating the difficulty value of each item, hundred questions were selected for the final test, and arranged in order of their difficulty. As a rule the items correctly answered by 50% of the Ss were selected for inclusion in the final test.

1,000 children of all regions in U. P. and of all castes were tested.

A frequency distribution of the I. Qs of the total number of both sexes as well as their castes and communities was made. The mean I. Q., 6.6m of each group were calculated. The histograms show quite a close approximation to the normal curve.

### 33. Psychological tests at Lucknow Christian College.

K. APPASAWMY, Lucknow.

Psychological tests are being used in the following three fields :—

- (1) *Personality Ratings* on definite character traits, such as honesty, industry, co-operation, initiative, reliability, etc. The rating is done both by teachers and fellow-students. Attempt made to help the students to improve themselves.
- (2) *Aptitude Tests*. A series of tests has been designed and used to test professional or vocational aptitudes for Commerce, Engineering, Medicine, etc.
- (3) *General Intelligence* tests, and special tests for misfits.

### 34. The standardization of the Goodenough Intelligence Test for India.

P. L. SHRIMALI, Udaipur.

The present investigation is based on 2,500 cases collected from different parts of Mewar. The following are the main conclusions :—

1. The increase in score from grade to grade and from year to year is fairly regular. It would be more regular if the accelerated and the retarded children in the school be removed from consideration.

2. School children in Mewar are considerably retarded.

3. The co-efficient of reliability of the Goodenough Intelligence Test is  $.77 \pm .06$  (based on 70 cases).
4. The co-efficient of correlation between the Goodenough Intelligence Test and the General Intelligence Test is  $.55 \pm .03$  (based on 229 cases).
5. The co-efficient of correlation between the Performance Test (Drever and Collins) and the Goodenough Test is  $.84$  (based on only 16 cases).
6. The distribution of I. Q. in 2,363 cases has been investigated on the basis of the norms of the present investigation.
7. The points about clothing need revision.
8. The standard of the drawing is seriously affected by the mood of the children.

### 35. Some statistical studies about the Civil Selection Boards.

P. D. SHUKLA.

The identity and functions of the Civil Selection Boards have been discussed in detail in an earlier paper. The object of this paper is to make a statistical study of certain aspects of these boards.

1. The reliability of the tests in the intelligence tests battery has been worked out by two different methods—the split-half method and the Kuder-Richardson method (*Psychometrika*, II, 2 (1937), pp. 151—160). It comes out to be of the order of 0.9 for each of the intelligence tests separately. The relative value of each of these methods has been estimated.

2. The scores obtained by the Central Service candidates are observed to be lower on the verbal intelligence test (VIT) given in English than the corresponding scores by the Imperial Service candidates; while on the non-verbal intelligence test (NIT), this difference is not much. The question whether this lowering of scores is due to the difficulty of the language has been discussed by the help of the regression equation of VIT score on the NIT score for Imperial Service candidates. It has been concluded that the language factor does affect the Central Service candidates but not to a marked degree.

3. By the use of a correlation method for qualitative series, the various correlations and inter-correlations between the candidates' 1—Final Grade, 2—Rank, 3—Intelligence Rating, 4—Pointer Grade and 5—GTO Grade have been worked out and the following correlation matrix is obtained:

	FG	Rank	IR	PG	GTOG
F G	...	...	.50	.64	...
Rank	...	...	.27	.36	...
I R	...	...	...	.59	...
P G	...	...	...	...	.81

Other correlations are still being worked out. Some of the assumptions involved have also been explained.

4. Initial findings resulting from the use of the partial regression equation for final grade on the candidate's intelligence rating, rank and pointer grade, suggest that differences in the location and personnel of three Civil Selection Boards have not resulted in gross differences in their standard of gradings. This appears to be true even after omission of pointer grade, which may be in some degree subjective, as a predictive factor.

### 36. Distribution of manual dexterity among the deaf, the blind and the normal students.

D. L. AMIN, Mysore.

The paper reports the data and the conclusions obtained from the six manual dexterity tests, conducted on three groups of students. There were 40 normal, 29 blind and 14 deaf students with a mean chronological age being 14½ years. They came from the same socio-economic level (lower middle class and the poor class).

The conclusions obtained are that the deaf students are not inferior to normal students in manual dexterity. The loss of sight handicaps the manual dexterity.

## 37. Group differences in intelligence among the deaf and the normal students.

D. L. AMIN, Mysore.

The paper reports the data obtained by conducting three intelligence tests, on two groups of students having the same mean chronological age, *i.e.*, 14½ years and coming from the same socio-economical level, one being deaf and the other group being normal. The number of the deaf students tested is 14, while that of normal group the number is 40 with the age of 14 to 15 years. The tests administered were the passalong test, the cube construction, and the Links form board.

The following are the conclusions : 1. The deaf students are not inferior in intelligence to the normal students ; 2. The deaf students tend to be superior to the normal students, in the ability to perceive space relations.

## 38. Officer Selection procedure.

K. G. RAMA RAO, Jubbulpore.

The paper discusses the S. P. Directorate tests, testing technique, and the method of treatment of the results.

## 39. Correlation between English Grammar and Composition.

K. D. GHOSE, Calcutta.

Years ago an experiment was conducted by the present writer on the question of correlation between English Grammar and Composition in the case of Bengalee boys in the two topmost classes of the Ballygunge Government High School, Calcutta and the correlation was found to be fairly substantial. This proved to be contrary to the results obtained by other studies on the same subject in English and American Schools. Possible causes of this difference in results. A recent study embodied in a thesis on the subject from the Patna University sent to the writer for examination confirmed the American results of a positively low correlation between English Grammar and Composition. This necessitated a re-examination of the whole question and the present experiment was conducted by the writer with the help of the Head Master, Ballygunge Government High School and Professor A. Moktader of the David Hare Training College in the two topmost classes of the school. Fifty-two boys on the whole were examined, 27 in class X and 25 in class IX. The Correlation as obtained by the rank-difference method in each case was +.49 which is a substantial correlation. It may be noted in this connection that this Correlation of +.49 when converted to "r" becomes +.61. The questions framed as objectively as possible. Results may be checked by further investigation on relationship between Vernacular Grammar and Vernacular Composition. Conclusion.

## 40. A study in Hindustani of free associations of schoolboys to Kent Rosanoff list.

P. N. MEHROTRA, Lucknow.

The first 50 words of the Kent Rosanoff list were translated in Hindustani and free associations to them were obtained from 265 boys belonging to classes V to IX of 3 different schools of Lucknow. O's were given practice with 4 words and were tested as class groups.

The data obtained for 12-year boys were used to construct frequency tables to each stimulus word, which were further analysed for determining the commonest response to each stimulus word and the extent of variation in responses to each stimulus word.

There was considerable evidence of perseverance and the tendency to repeat the stimulus word in the age-group studied.

## 41. Standardisation of aptitude tests for compositors, machinemen and binders.

K. L. AGARWALA, Allahabad.

The trial battery composed of the Passalong Test, the Peg Board, the Form Board, Colour Discrimination, Colour Matching, the Block Test, and the Linear Span Test were tried out on random samples of 20 each selected from the three sections of the press, the composing room, the machine room and the bindery.

The standardisation was made on 250 men drawn from each of the sections mentioned above. The tests were suitably selected and grouped for each section separately.

The statistical analysis of the data yielded the following results :

	Compositors			Machinememen			Binders		
	M	S.D	Y with proficiency	M	S.D	Y with proficiency	M	S.D	Y with proficiency
Passalng ... ..	16.3	8.2	0.48	17.2	7.7	0.6	12.9	7.1	0.38
Peg Board ... ..	55.9	19.9	0.42	52.4	21.6	0.49	53.4	21.3	0.49
Form Board ... ..	47.9	23.9	0.49	48.0	19.9	0.50	...	...	...
Colour Discrimination ... ..	...	...	...	45.5	22.48	0.46	...	...	...
Colour Matching ... ..	...	...	...	40.7	19.9	0.42	...	...	...
Linear Span ... ..	...	...	...	...	...	...	9.1	5.4	0.5
Block Test ... ..	...	...	...	...	...	...	51.2	24.2	0.56
Proficiency ... ..	19.58	5.7	X	19.35	6.46	X	16.02	7.47	X
Mean of the Whole Battery ... ..		118.1			196.9			114	
		39.8			55.2			39.4	
Multiple r. ... ..		0.76			0.86			0.89	

Some significant results are reported and suggestions are put forward for (1) the proper use of standardised tests for vocational guidance and selection, (2) securing a flexible device for using the standardised scores of other countries, and (3) for the proper organisation of a printing press.

## Educational and Child Psychology

### 42. School psychological and welfare services.

K. G. RAMA RAO, Jubbulpore.

1. Present Status: (a) Method of age grouping in schools is chaotic. (b) Educational guidance is conspicuous by its absence. (c) Even children of elementary school age are subjected to the ordeal of formal examination. (d) School welfare services are nowhere provided.

2. School Psychological Services: (a) Constructional-Diagnostic: Developmental testing and preparation of personal and family case file of school-beginner. (b) Applicative-Prognostic and remedial: Child guidance, educational guidance and vocational counselling. (c) Educational and instructional testing to replace formal examinations and to introduce new purposes to school instruction.

3. School Welfare Services: (a) Visiting teacher service—a form of liaison service between school and home. (b) School attendance enforcement. (c) Subsidised physical welfare services, such as provision of milk, meals and clothing. (d) Organisation of parent-teacher associations.

4. Education Department, C. P. and Berar, is organising school psychological and welfare services centres. The psychological clinic at the Spence Training College has service sections for (a) child guidance, educational and vocational guidance, employment and selection counselling, (b) training personnel for both psychological and welfare services.

The underlying assumption is that a school (or educational) organisation aspires to become, and justly so, the centre of not only school psychological but school and community welfare services in a Social Service State.

43. "An investigation for reviewing the primary syllabus in arithmetic on an experimental basis."

BIPIN VIHARI SRIVASTAVA, Psychological Institute, Patna.

To determine whether the colossal wastage and stagnation in our primary schools are due to bad pupil material or defective curriculum, 400 children of class Infant to III were tested by means of a non-verbal performance test which is independent of schooling. The medians of mental ages were found to be 73, 94, 110 and 129 months in ascending order, whereas the syllabus has been framed for boys of age 60, 72, 84 and 96 months, respectively. This conclusively proved that the pupil material was not at all bad. Statistical analysis revealed that the median scores in arithmetic were the lowest. The pupils were next tested by attainment tests in *arithmetic*. Experiments confirmed the conclusion that the syllabus was defective to the core. The experiment suggests that sums on each fundamental process should be classified into important types, and the suitable mental age for teaching each type of sum should be experimentally determined. This will provide a scientific basis for framing a syllabus on fundamental processes for each class perfectly graded in ascending order of difficulty.

44. The Montessori method and Gestalt psychology.

(MRS.) LEELAVATHI M'RAO, Allahabad.

*Gestalttheorie and sense perception :*

Perception of "figure" against "ground" : conditions favourable for perception of wholeness.

*Behaviour in infants :*

Organised behaviour brought about according to the organismic law. The conception extended to structural development in the pre-natal and post-natal stages leading to the establishment of continuity of development.

*Montessori's conception of child nature and of purpose of education :*

Early post-natal stage described as that of the "spiritual embryo," physical embryo being the pre-natal one. Similarity in the development, structural and functional, between the two stages.

Child at birth possesses latent psychic functions of a pre-determined pattern which should be allowed to develop freely in a specially prepared environment. Education develops the whole personality of individual in society through this special environment.

*Method of education in early childhood :*

Training of sense perception through motor activity to achieve muscular co-ordination and also harmony between mind and body.

*Sensory exercises :*

Isolation of a quality presented before gradation, to make "figure" stand out prominently against "ground" in Gestalt terms.

Identity before gradation—similar purpose.

Co-ordination after differentiation.

*Montessori method of sense-training and Gestalt psychology :*

No contradiction in basic principles. Unity of development—physical, mental and social. In addition, psycho-analytic principles are included in the Montessori method.

45. A Neo-Hormic foundation for education.

S. P. CHAUBE, Allahabad.

In the current curricula there is neglect of child psychology. The child's instincts, interests, purposes and spontaneous capacities are overlooked. His unconscious is ignored.

The chief aim of education cannot be fully achieved unless the unconscious workings of the human mind are explored and a suitable environment is provided according to the child's particular needs. A synthesis of the findings of McDougall and Freud gives us the most satisfactory basis for human psychology. This synthesis, which we term *neo-hormism*, is the proper foundation for education.

## 51. Psychology of individual attention at school.

K. L. BORDIA, Udaipur.

Individual attention is the central feature of the work in Vidya Bhawan.

Every boy is allotted to a group in which there are four or five teachers and fifty to sixty boys. The groupmaster maintains a record of progress in health, studies and character development. Emotional difficulties of the child are specially attended to.

Better attention can be paid to resident students. Sixty to seventy children, from the age of five to eighteen, are distributed in five hostels formed on the basis of age.

*Ways of tackling difficulties.*—

1. Attention to health.
2. Intelligence Testing.
3. Provision of crafts, hobbies, art, music, dancing and dramatics to draw out individual aptitude and to canalise aggression.
4. Removing the cause of emotional insecurity.
5. Psychiatric treatment.

*Some Cases*—

- (1) Problems of childhood.
- (2) Problems of adolescence.

*Difficulties*—

- (1) Insufficient co-operation from parents.
- (2) Lack of duly qualified teachers.

*Danger*—

Increase in the number of difficult children.

*Conclusion.*

## Social and group Psychology

## 52. Mental testing in schools.

A. T. MUKHERJEE, Nabadwip.

Adequate knowledge of the distribution of abilities in the school population is a fundamental pre-requisite on which the adaptation of teaching to individual ability mostly depends. Apart from the various psychological tests for determining physical and intellectual capacities, experimental investigations based on the law of distribution of human abilities and the normal curve of distribution obtained, when frequencies are plotted against the values of the trait, enable the modern teacher to standardize tests, more scientifically, to determine norms for various age-groups and classes, to test the homogeneity of a particular group of pupils and to arrange test-questions on order of difficulty.

Modern schools recognise the value of activity in the class-room, individual development in the social situations, originality, creative stimulation, development of the child's initiative and imagination and the spirit of effort and adventure.

Experiments on external "psychic phenomenon" suggest a compromise between collective teaching and individual teaching on the basis of nationalism with international aspects.

## 53. Interest and ability.

ABDUL QUYUM, New Delhi.

1. *Definition of the problem*: Typology derives its strength from tests. While "ability" is more or less satisfactorily encompassed by tests, those for interest or "temperamental qualities," even where most successful, are in the nature of a happy guess. "Interest" is on the one hand difficult to gauge or predict and on the other more powerful than "ability" or intellect. The problem therefore poses itself thus: can there be the presence or abundance of one without the other? What are we to do with either of these without the other?

2. A change in outlook helps. What is ability? Ability should mean actual performance, *i.e.*, a result of the interaction between all the determining factors in the make-up of an individual. Interest, again, should mean a dynamic function rather than a sterile desire or wish. Viewed thus, interest and ability merge into activity and, apart from exceptions, the one would normally be indistinguishable from the other.

3. With this consideration as the background is described a research experiment with "backward children" of a specific type, *i.e.*, average or above so far as intelligence tests go, but backward in their performance in Schools. An occasional peak of efficiency found in some was considered on accident, and in fact a support for the belief that ability was temporarily hampered.

4. The children (all of them between the ages 7 and 11 and males) were studied in individual interviews for 1 to 2 hours for 3 to 5 days in a week in a psychological laboratory. All possible information in the form of teachers' opinions, school records, family situation, playground behaviour, etc., was collected. Verbatim record was made of the child's answers and other conversation which related to the whole of his life including his attitude towards teachers, parents and playmates. An attempt was then made to formulate the causes of backwardness.

5. Though the experiment was broken off at this stage, the study of children remaining incomplete, the belief that backwardness in these cases was primarily due to an unconscious hostility either towards one or both parents, or one or more teachers or towards both parents and teachers, finds some substantial support.

#### 54. Some psychological factors in the conflict of political ideologies in India.

H. P. MAITI, Patna.

The paper gives a short account of the principal ideologies that are dominating in the political life in India at present, and tries to delineate the psychological mechanisms that seem to underlie them, and their mutual interaction.

#### 55. A psychological approach to the problem of minorities.

M. Z. ABDIN, Patna.

The problem of minorities is primarily a psychological one. The term "minority" is not a statistical concept, but a psychological one. Minority consciousness arises from a sense of subordination of a group by a dominant group. It is the sense of subordination which gives rise to the feelings of insecurity and loss of prestige. These in their turn give rise to characteristic reactions of minority groups. In order to understand the nature and significance of minority groups, their subjective and objective positions have to be understood. The increase of social distance between a minority group and a majority group further complicates the problem and makes mutual understanding difficult.

Four different kinds of minority groups, namely, the *pluralistic*, the *assimilationist*, the *secessionist* and the *militant* can be distinguished, according to their objectives and activities. These four types of minority groups are determined by the nature of relationship existing between the majority and the minority groups. Each of these have different ideals and goals which they strive to achieve. A minority group does not remain in any one stage but passes through successive stages.

#### 56. A case for revival of cottage industries in India—A psychological study.

A. K. P. SINHA, Muzaffarpur.

This paper makes out a case for revival of cottage industry on psychological grounds. The introduction of large-scale mechanised industry will involve the following dangers:— Firstly, the villager is accustomed to spasmodic work in open air; secondly, the nervous tension is increased because of speed, noise and clatter of machine, and divorce of the worker from the soil; thirdly, it creates a chronic dissatisfaction among the workers because of extreme regimentation and the scant opportunity offered for the play of the craftsman instinct; and lastly, it makes for monotony, boredom, and mental derangements. The cottage industry is not only free from the defects of the mechanised industry, but possesses the additional merits of (a) narrowing down the gulf between the rich and the poor, (b) strengthening the incentives to work, and (c) maintaining the sense of national pride and superiority. Thus, the cottage industry should be revived and further supplemented, wherever necessary, by big mechanised industry keeping in view that the economic, social and psychical aberrations are eliminated or at least reduced to a minimum.



## 57. Four phases of students' year at the Indian Universities.

B. L. ATREYA, Benares.

A student's university life has the following four phases :

(1) The political phase—in the first term, elections strikes, ventilating grievances, asserting rights and privileges occupy the students' time. In such an atmosphere the slightest irritant often leads to disputes between staff and students. Psychologically, these disruptive phenomena are partly due to the students' mental distress and anxiety just before joining the university and partly due to the repression of their emotions at home. Being free now, they give unfettered expression at last to their long suppressed feelings.

(2) The social phase—in the second term we notice numerous pleasing social activities with characteristic co-operation between staff and students in the university.

(3) The studious phase—students in the third term settle down to their studies and burn the midnight oil over the books.

(4) The religious phase—after the examination and before the results are published students become religious minded, visit temples, and worship the deity for success. So their character gets refined.

Bearing in mind these facts the educationist should evolve such a system as will benefit the students and the nation alike.

## 58. A psychological probing into national shortcoming.

K. APPASAWMY, Lucknow.

Every nation has its shortcomings. We are highly individualistic. Our music is highly individualised melody and not harmony. The yoga system is another highly individualised self-development. Due to too much individualism we lose the advantages which accrue from team spirit. We want something more than we have paid for.

*Wrong process of thinking :*

Mistaken kindness or indulgence given to children, claimed as our right when we are grown up. Misplaced sympathy; right or wrong our sympathy is always with the sufferers. Our loyalty is more to the past than to the present. We unite on the negative rather than on the positive causes. We set a higher standard for others but we do not follow it ourselves. We are critical, argumentative but not always constructive.

What are the root causes of these? Our country of culture? Our food? Our historical development? Our religions? Our physical make-up? How and what shall we do about these?

**Psychology of Religion.**

## 59. Field structure of desireless devotion.

S. K. MITRA, Psychological Institute, Patna.

Devotion is of two types : (1) in which one is devoted to God to achieve something mundane which one desires and (2) in which one is devoted to God for the sake of devotion itself. It is the second type of devotion that is called Desireless Devotion.

Desireless devotion as an attitude has two important aspects : (i) affective and (ii) orrectic.

An attempt is made in the paper to describe the phenomenon in terms of field dynamics. In a bounded and limited psychological field a vector is supposed to be acting on a point-region which represents the ego or the self. This vector is directed to a goal which is quasiconceptual and has a positive valence. A barrier between the point-region and the goal represents the felt gap between the devotee and God. The barrier appears to be impermeable.

Further problems are indicated.

## 60. Transformation (a psychological study).

INDRA SEN, Pondicherry.

Is transformation, a fundamental change of human nature, impossible ?

Among Western thinkers Karl Marx affirmed that human nature could be radically changed through the change of environment. Freud vaguely suspected that perhaps in the mystic experience the dualities of our motivations could be surpassed and exceeded.

To Indian Psychology it is an old familiar truth that the divisions and dualities of human nature can be made good. The Brahma-Sthithi, the whole undivided consciousness of the Gita, is a fact testified by generations of daring seekers of the deeper truth of human nature. With Sri Aurobindo transformation of human nature becomes a practical undertaking of life.

In 'transformation' first there occurs a conscious self-dissociation from the normal fixations of life, and then a progressive penetration into the sub-conscious involving a reversal of natural valuations. The test of the genuineness of the change will lie in the spontaneity and the relative absence of repressions achieved in life.

This paper is an attempt at showing that transformation is a psychological possibility. It also delineates the two essentially psychological processes involved in it.

## General Problems of Educational Science

### 61. Principles of script reform applicable to the various languages of India.

B. KUPPUSAWMY, Mysore.

(1) If one uniform sign is adopted for the long sound the number of vowels and consonant-vowel forms which the child and illiterate adult have to learn will be greatly reduced.

(2) At present the 'O' sound is written by combining the symbols for 'ē' and either plain long sound or the long sound for 'u.' Instead, one symbol, preferably the opposite of that for 'ē,' may be used to express the 'O' sound.

(3) If the vowel signs are written to the right of the letter instead of above or below, the task of the printer and typist will be greatly reduced.

(4) One uniform sign, a vertical dash, below the alpap-prana will eliminate the special letter-forms for maha-prana.

(5) The sajatiya samyuktaksharas can be written with one sign instead of repeating the letter or giving the 'vottu.'

(6) The 'vottu' may be completely eliminated in Telugu and Kannada and the vijatiya ssmiyuktakshara can be written as pronounced in the Devanagari languages and Tamil.

If the above proposals are accepted the number of alphabets can be reduced from 50 or 52 to 28 or 30. Uniform principles will be introduced and the task of the learner can be reduced by one-third in some languages and by one-half in others. The work of the typist and printer will be greatly reduced.

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## SECTION OF ENGINEERING AND METALLURGY.

PRESIDENT: H. P. BHAUMIK, B.A., C. & E.E. (Roorkee), O.B.E., M.I.E. (Ind.)

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### 1. National planning—stable regime in an alluvial river.

K. B. RAY, Calcutta.

The variable nature of the soil and the power of erosion of running water have helped to form the river channels. But these very properties of land and water, when unguided, have destroyed millions of bighas of fertile land, and India has now to send Food Missions to beg for food. The erosive power of running water varies as the square, while its power of transportation of silt varies as the sixth power of its velocity. Variations of velocity, at different sections in the length of a river, cause the flowing water to erode its bed and banks at one point and deposit silt and form sand bars or islands at another, so that the channel is never constant and there is no stable regime. A uniform width and section of channel is necessary to ensure a uniform velocity, which is essential for a stable regime. For smaller channels, such as a municipal drain, a uniform velocity is maintained by replacing a wide and shallow *kutcha* drain of varying widths by a narrow and deep *pucca* drain, with a uniform section. A river, after all, is a drain of colossal magnitude. The "levees" maintain a uniform section and thereby form a uniform velocity in the Mississippi, but levees are very costly and have certain disadvantages. A series of pairs of guide banks, spaced at distances equal to 26 times the standard width of a river channel, can maintain, more economically and without the disadvantages of the levees, a uniform section and a uniform velocity and thus establish a stable regime in an alluvial river.

### 2. Plastics insulation for electric cables and wires.

S. N. MUKERJI, Calcutta.

The paper is an attempt to discuss the development of plastics insulation in the field of electric cables and wires. The fundamental properties of electrical insulating materials, *viz.*, conductivity, permittivity, dielectric loss and electrical strength are first explained. The correlation of electrical and chemical properties in respect of electrical insulating materials is then briefly reviewed as this is the starting point in the search of substitute plastic materials to serve as insulation. It is explained that polar materials or the presence of polar groupings tend to result in unsatisfactory electrical properties and non-polar materials such as hydrocarbons tend to have good electrical properties. The reactions involved in plastics formation lead to the production of a stable electrically desirable structure. Although thermosetting resins have so long been used practically exclusively for electrical mouldings, in recent years thermoplastic materials such as polythene, polystyrene, etc., has opened up new possibilities for electrical equipment. The substitution in the field of cables is reviewed by considering the fields of high voltage, medium and low voltage and high frequency. The difficulties in the region of high voltage owing to arduous conditions are explained and, although the substitution is slow, there is a very distinct trend in development in which polystyrene, polythene, polyisobutylene and polyvinyl formal have been considered. In the region of high frequency, there has been a remarkable substitution with excellent results and the plastics named above are already being referred to as "high frequency dielectrics." In the region of medium and high voltages, most spectacular results have been obtained and the plastics insulated cables bid fair to be a serious competitor to rubber insulated cables. The electrical properties and merits of polythene, polystyrene and polyvinyl chloride, are then discussed in somewhat more detail. It is shown that by the use of polythene insulation the number of available channels in submarine cables can be increased by about 15 per cent. A first-class trans-continental telephone service would be possible by polythene insulated submarine cables with the development of submarine repeater stations. The use of plastics insulation for magnet wires is discussed in detail and it is shown that magnet wires insulated with polyvinyl formal as substitution for enamel wires have great possibilities. The use of nylon as a wire-coating material is also discussed and it is shown that an extremely tough coating which is capable of withstanding considerable abuse is possible.

### 3. Technique in the manufacture of runner bricks for steel casting.

N. S. SHANKARNARAYAN RAO, Bhadravati.

In no other industry are the refractory requirements more varied and specialised than in the steel industry and the successful making of steel depends to a large extent on the quality and efficiency of the refractories which it uses. The object of this paper is to give a brief review of the varieties of technical problems that were confronted during the development and manufacture of one particular type of refractory, *viz.*, the runner brick in an Indian steel-making concern.

### 4. Basic open-hearth furnace practice at the Mysore Iron and Steel Works, Bhadravati.

H. P. DORESWAMIENGAR, Bhadravati.

The paper describes in detail the original construction of the furnace and its features. The various improvements made and mode of construction are dealt with elaborately. The adaptation of water-cooling system in different parts of the furnace such as gas ports, skew-backs, back-wall and front pillars is indicated. The main theme of the paper is the introduction of *chrome-magnesite bricks in the various parts of the furnace*. The nature of raw-materials used and especially the difficulty experienced in using a very poor quality of coal is discussed. The accessories to the furnace, melting, heat-working and finishing the steel are mentioned. Bottom pouring of ingots, ingot size, ingot moulds and their life is given. Consumption of various ferro-alloys used in the operations are given. Finally, how the life of the furnace has increased from one campaign to another by the several improvements above stated is mentioned, as also the different class of steels manufactured.

### 5. Automatic recording of fading of radio signals.

S. S. BANERJEE and G. C. MUKERJEE, Benares.

During the course of our investigations on observations of fading of short-wave signals (*Science & Culture* 11, 571, 1946) the necessity was felt of developing an automatic recorder for delineating the variations of signal intensities as received in an aerial. The paper describes the method and apparatus for obtaining a continuous and visible record of such variations of received signal strengths with ink on paper, as the usual light on photographic film method is found to be very costly and unsuitable for immediate use.

The rectified voltage from the second detector, obtained from a radio signal received in a 5-valve superhet receiver built for the purpose, was tapped and amplified by means of a 2-valve direct-coupled amplifier with neon coupling. This amplified voltage was applied to a recording galvanometer attached with a pen. The paper for recording was run by a self-governed electric motor and the speed of paper could be varied from 2 to 6 cm. per minute.

The deflection of the recording galvanometer was calibrated for receiving field-strengths by means of a shielded oscillator which fed a frame aerial with tuning condenser through a pair of shielded transmission lines. The high frequency current circulating in the aerial was measured with a thermo-couple type radio-frequency milliammeter. The small high frequency voltage, developed across the impedance of a large-value condenser in the aerial circuit, was injected to the input coil of the receiver through a suitable attenuator. The field-strengths developed were calculated from the knowledge of the constants of the frame aerial and the deflection in the recording galvanometer was calibrated for different intensities. The induced effect of the frame aerial was reduced to minimum by adequate shielding and eliminated before calibration.

### 6. Solvent extraction in packed and air-agitated columns.

T. R. VISWANATHAN and S. K. NANDI, Bangalore.

The performance of different types of continuous counter-current extraction columns for the system nitrobenzene-acetic acid-water is being studied and some data on packed and air-agitated columns are reported. The air-agitated column, because of the very intimate mixing of solvent and solution during operation, gives the highest efficiency. The numerical values of the overall extraction co-efficient  $K_{Na}$  for the air-agitated, spray and packed columns are 15.4, 6.5 and 2.9, respectively, keeping all other factors constant. The distance between the nitrobenzene inlet and the air affects  $K_{Na}$ , the values being 15.4, 7.8 and 5.3 when the nitrobenzene inlet and air-jet are separated by 26, 12 and 6 inches, respectively.

In the packed column, the variation of flow rate of one phase keeping the other constant was studied with nitrobenzene dispersed. Keeping nitrobenzene flow constant at 20.0 cft./hr./sq. ft. tower cross-section, the acid flow was varied from 5.5 to 57.0 cft./hr./sq. ft., the values of  $K_{Na}$  changing from 2.9 to 3.4 and those of  $(H.T.U.)_{ON}$  from 6.8 to 6.0 feet. Keeping acid flow constant at 20.0 cft./hr./sq. ft., the nitrobenzene flow was varied from 7.5 to 55.0 cft./hr./sq. ft., the values of  $K_{Na}$  changing from 2.0 to 6.4 and those of  $(H.T.U.)_{ON}$  from 3.8 to 8.6. These results indicate that the overall extraction co-efficient  $K_{Na}$  depends on the flow rate of nitrobenzene, and only slightly on that of the acid solution. The poor performance of this packed column is due to the comparatively large size of the packings. It is expected that, with packings of smaller size, the efficiency will increase and further work in this line is in progress.

## 7. Detection of amplitude modulated signals.

R. NATARAJAN, Madras.

The  $3/2$  power law between input voltage and plate current is a classical law for vacuum tube phenomena. It is generally pointed out that the characteristics of the tube do not obey this law but a square law (which has no theoretical basis) but is found to characterise the non-linear nature of the tube impedance. It is the purpose of this paper to show that the  $3/2$  law furnishes on analysis as complete a picture of rectification as any simplifying practical law not based on accepted theory of vacuum tube operation. It shows that the statement usually made that the vacuum tube does not in practice obey the  $3/2$  law but a square law is wrong and that the real fact is that the square law is a practical approximation of the  $3/2$  law which latter is actually obeyed by the characteristics. Any observed departure from this should therefore be logically attributed to the shortcomings of the methods of experimental observation. In this paper, the rectified current is worked out assuming the  $3/2$  law and with an amplitude modulated input. The cases handled are: (i) where there is no input condenser across the input circuit which is not a practical case and (ii) the usual detection circuit in a wireless receiver.

It is pointed out that, though this paper does not give any new result, it provides the valuable links between theory and practice in radio engineering. It is believed that the only difficulty in extending this to frequency-modulated-signal-detection is the mathematics of the analysis. That for the case undertaken involved the integration of gamma functions of higher orders and often a combination of the gamma and elliptic integrals. That rectification can be shown to take place in a vacuum tube theoretically, as done by me in this paper, removes the empiricism that surrounds the basis of radio science.

## 8. One railway gauge for India.

H. K. RAMANUJAM, Bhadravati.

In recent years, we have been hearing and reading of many plans for developing the natural resources of the country and making the country self-supporting and thereby attempting to raise the standard of living of the average citizen. It is under contemplation to start new basis industries, consumer goods industries and other ancillary developments. Railway transport has been our bottleneck these years and further expansions in the country will aggravate our difficulties. The difficulties experienced by men and materials due to the adoption of different gauges have been explained in brief to open the eyes of our leaders for studying and examining this aspect of this important question in great detail and all further developments have to be planned with the above in view. The object of this short paper is to press for an all-round expansion of a well co-ordinated railway system adopting only one gauge for the whole of the peninsula.

## 9. Power for our dumb millions.

J. N. BASU, Jadavpur.

The scientists, engineers, administrators, politicians, industrialists and businessmen are taking more interest in the problem of power in India in recent times. In 1940, the sub-committee "Power and Fuel" under the National Planning Committee found out the installed capacity in India to be 1 million K.W. and the energy index to be 8 K.W.H. per head per year in India. The low energy consumption *per capita* in India is attributed to the meagre national income of Rs. 65 per year. Mr. H. M. Mathews, Chairman, Central Technical Power Board, later corroborated the above findings by statistics.

Out of 3578 millions K.W.H. generated in India in all her power stations, both thermal and hydro-electric, only a small fraction of it, *viz.*, 1.9% is consumed for irrigation and agricultural dewatering. The major portion of it is utilised in industry and in urban areas. Only 1,200 out of 657,000 villages in India have some sort of electric service, so 89% of our population of 390 millions living in villages, whom we call the dumb millions, are deprived of any facility of power which is so badly needed at least for irrigation if not for other purposes, in villages where food for the whole nation is to be produced in order to be assured of avoidance of future famine.

Different ways of supplying power in rural areas are narrated ; harnessing of wind-power especially in isolated rural areas is discussed in length. There are special facilities of wind-motors ; one of them is that the mill runs without any running cost. Hence it is very suitable for irrigation, as agriculturists here cannot afford to pay much for irrigation ; besides the disadvantage in power-generation due to irregular wind-velocity, does not affect the problem of irrigation so materially. The installation cost is nearly Rs. 15,000 per square mile to the extent of 22.5 K.W. installed thereon. At present the installed K.W. per square mile in India is .79 K.W.

#### 10. Field test for the analysis of lime mortar.

G. RAMARAO, Hyderabad-Deccan.

Lime mortar is an important structural material specially for foundation work and the strength of the superstructure is entirely based upon the correct proportion of lime and sand in the mortar. Therefore a rapid and reliable method for the analysis of lime mortar at the site is of great value to the building engineer. This paper describes a simple method which can be carried out by anyone with a graduated jar and dilute hydrochloric acid which gives the correct proportion of lime and sand in the mortar.

#### 11. Engineering education.

T. SEN, Jadavpur.

*I. Introduction.*—The purpose and problems of engineering education—its responsibilities to the public and the profession and also to the students as individuals. Its duty is to equip the students with an attitude and background appropriate to effective citizenship and also to supply to the industries suitable professional personnel in the engineering profession and business management. It should also provide the students with an educational programme in which the students are allowed to achieve the maximum development of mind and character.

*II. Curriculum.*—Besides teaching an engineering student the basic fundamentals of mathematics, physics, and the manufacturing process of to-day, the curriculum should include instruction in humanities and inculcation of a sound philosophy of life based on objective truth which should be able to protect him from the passing and ephemeral changes of political opinion. The mission of the engineer is to do the greatest material good to the greatest number and no course of instruction should lose sight of this aspect of the matter. The students must be taught to respect truth and develop proper engineering attributes.

For years the world has been ruled by lawyers, statesmen and politicians. Now the age of the engineer has come with problems of mass transportation, mass production and mass redisplacement. The engineer should be fully equipped with instruction to be able to solve these pressing problems of the society. There should be a closer link between him and the community. Peace and world order imply not only a pooling of trade of economic development but also pooling of engineering and scientific knowledge of the whole world. For this reason, the engineer should have a comparative education about the conditions of the different countries of the world. The curriculum should, therefore, be broadened to include courses in foreign government, world trade, political philosophy and foreign languages in addition to research in various problems of different countries.

*III. Teachers.*—A great responsibility rests upon the engineering teacher—a responsibility alike to his students, to his community and also to himself. He must see that his students are directed to their proper field of specialisation and he should also be alert to the needs of the society. Moreover the students under his care should be so trained that they may be able to play their part in the wider sphere of national life.

**IV. Research.**—The scientific progress in many specialised fields of engineering has now been so varied and rapid that it is not now possible for a young man to grasp and master it all in the four years of his college training. Therefore, engineering colleges should provide another year for post-graduate work. The graduates should be encouraged to investigate new and unknown paths of engineering science.

## 12. Possibilities of complete Steel works without metallurgical coke.

N. S. SHANKARIAH, Bhadravati.

With the established processes of electric smelting and steel making in electric furnaces, it is possible to build a steel works without the necessity of using metallurgical coke. The power and charcoal or coke consumption per ton of steel ingot in a hypothetical plant producing 120,000 tons of ingot per annum are worked out and it is shown that a ton of finished steel could be produced with an expenditure of 2,800 K.W. and 0.4 ton of charcoal with a combination of electric pig iron and sponge iron furnace and with only sponge furnace 2,030 K.W. and 0.2 ton of charcoal would be required. It is suggested that, in the interest of the future of the industry, it is desirable to investigate the possibilities of such process on a commercial scale.

## 13. The occurrence of corundum near Haradur, in Arakalgud Taluk, Mysore State.

K. V. KRISHNAMURTHY RAO, Lashkar, Gwalior.

The natural resources of a State are always an asset. The proper utilisation of the natural resources combined with the development of its artificial counterpart accelerates the development of the country. In India this is essential, at present. It is in this setting, that the development and proper utilisation of its corundum deposits occupy an important place in the expansion of our industries. The Corundum deposits of Haradur, in Arakalgud Taluk, add an important amount to the estimated deposits of the mineral in Mysore and India. They may be expected to yield at least 100,000 tons of clean corundum ready for abrasive manufactures.

Here, corundum occurs in Pegmatite as big boulders, almost similar to the Pipra occurrence. All the corundum occurs at the contact of the Pegmatites, which are highly micaceous and the Ultrabasics, a branch of the Holarasipur Schist belt. The boulders consist of pure corundum-rock, kyanite-corundum-rock and kyanite-sillimanite-corundum rock. The corundum is generally massive and the sp : gr : varies from 3.84—3.98. Color is pink or violet. White types are not rare. These boulders occur two furlongs east of Haradur, along a band about 150 feet wide and half a mile long, in groups or clusters. Bunches of opaque pink to bluish crystals are found in the Kyanite-Sillimanite-Corundum rock. A contact metamorphic origin is assumed from the available evidence.

## 14. Typical design of sewerage system.

P. C. BOSE, Calcutta.

### 1. Historical background.

The first big modern sewer was constructed in New York in 1805. Not till 1815 human excreta was allowed to enter into London sewers. In the middle of the 19th century a start was made in construction of sewers in Calcutta and Bombay for the disposal of human excreta, waste-water and rain water. In spite of comparatively early start, little progress has been made in sewerage other major cities and towns in India.

### 2. Ideal sewerage system.

Ideal sewerage system should take care of waste sullage human excreta and storm water and should deliver its contents to the disposal plant in fresh condition. Sewers should be so constructed as would prevent contamination of surrounding area through leakages and deposition of solid matters in the bed of same. Sewers should also withstand corrosive action of sewage and sewer gas.

### 3. Description of a township—Cossipore attached to Calcutta.

With the above objects a sewerage system for a township known as Cossipore has been designed. The total area is 2,100 acres. The population has increased from 47,000 in 1911 to 1,16,000 in 1941. The population would be 2 lacs in 1961. Water supply increased from .42 million gallons per day in 1911 to 3.5 million gallons per day in 1945. No water supply arrangement for flushing and street watering purposes exists at present. In the augmentation scheme of water supply to Calcutta, 20 million gallons should be earmarked for this area.



#### 4. Past and present drainage arrangement.

The area is served by open surface drains of which 36.14 miles is *pucca* and 22.29 miles is *kutcha*. All these drains had their outfall into the tidal canal of Bagjila which finally discharged into the river Bidyadhari. Due to the deterioration of Bidyadhari, the outfall channel of this silted up rapidly and the area remained water-logged. Temporary pumping arrangement has been made for draining the area but it is quite inadequate. A sewerage scheme for this area was drawn up in 1912 by the Sanitary Engineer to the Government of Bengal with a supply of 25 gallons per day per head for a total population of 1,60,000. In addition to the dry weather flow, provision of rain water of 1/40 inch per hour was made. The balance of the storm water was proposed to be drained through surface drainage system. The sewage was proposed to be treated in septic tanks and effluent from septic tanks was to be further treated in filtered beds. The scheme was not given effect to for paucity of funds.

#### 5. System of drainage proposed.

Combined system which receives sewage, industrial waste as well as surface and storm water is advocated in preference to separate system or partial separate system. Separate system of sewer becomes inadequate in growing town due to increase of population and increase in water supply. From practical experience gained in Calcutta and elsewhere, it has been established that combined system is more flexible and hygienic. The system to be linked up with Calcutta's outfall.

#### 6. Basis for sewer design.

The volume of rain water reaching the sewer varies with duration and intensity of rainfall, degree of saturation of the earth before and after the rainfall and the character of surface of the ground. In this case the sewers are designed with run-off co-efficient of 50% of the precipitation. The main sewers are designed for peak dry weather flow plus  $\frac{1}{4}$ " of rainfall per hour with 50% run-off co-efficient. The branch sewers are designed for peak dry weather flow plus  $\frac{1}{4}$ " rainfall with 100% run-off.

#### 7. Velocity of sewers in dry weather.

In sewers velocity not less than 3 feet per second is considered necessary as the sewage contains large percentage of grits due to road washing, scouring utensils with ashes and other habits of the inhabitants. The main sewer alignment sizes and calculations are described. Materials used for construction of main and branch sewers are considered. The pumping machinery and outfall sewer are described.

### 15. An Analysis of the problem of slum clearance and housing.

B. N. CHAUDHURI, Calcutta.

This article analyses the problem with a definition of overcrowding and the minimum accommodation required for a family. A standard of road width, sanitary convenience, household requirements and amenities, rent limit according to earning capacity, etc., are suggested to suit our country. Formation of a Board of Housing and Development with a procedure of work is also suggested.

### 16. Basic-to-neutral refractory from low grade non-refractory chrome ore.

H. K. MITRA, Jamshedpur.

Low grade Chrome Ore is not used at present for making Chrome or Chrome-Magnesite type of brick. Such ores are first beneficiated by physical processes before they could be used for refractory purposes. In the present investigation a highly siliceous Chrome Ore has been used, which is non-refractory and whose beneficiation by usual means would not lead to substantial improvement in refractory properties.

The ore has been chemically processed. By calcining it with magnesite at temperature not less than Orton Cone 30 (1650°C) dead-burned masses have been formed whose Refractoriness-Under-Load (Ta) is above 1700°C. They are found to contain Forsterite Spinel and Periclase. Bricks made from the dead-burned mass whether given a second firing or not but bonded with organic or inorganic binders are likewise found to show the same micro characteristic and Refractoriness-Under-Load value.

The temperature of conversion to Forsterite and Spinel can be lowered by the addition of such volatile fluxes as Boric Acid and Ammonium Sulphate. The former while aiding conversion lowers Refractoriness-Under-Load value.

Service Trials in steel melting furnaces show that the bricks developed in this investigation can be used in those zones of such furnaces where Chrome-Magnesite bricks are used at present.